

Motion Control PMC

PMCprimo 16+



1. General conditions

1.1. Copyright

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1.2. Notes

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The examples given serve only as illustrations. No guarantee is given for their suitability in particular applications. Although the utmost care has been taken in the production of this document, no liability can be accepted for any mistakes that it may contain. We welcome any suggestions for the improvement of our products, or documentation.

We reserve the right to make technical changes, which lead to the improvement of the product!

1.3. Previous editions

Edition	Comments
V1	Initial issue
V2	ATEX note added
V3	Buffer battery, battery change, battery warning notice
V4	Modem cable
V5	Revision

2. Table of contents

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3. Type key

The nameplate depict below describes the various configurations of the PMCprimo 16+.

to be included when placing an order	Type	Supply voltage
Order number	PMCprimo 16+ . 00 / _ / _ / _ / _	24 VDC

	0	1
without		
Profibus-DP/S Small (1)		

	2	3	4	5	6	7
without						
Motion						
Software SPS						
Interpolation						

	0	1	2	3	4	5	6
Slot 1 Extension card	without						
	CAN-2						
	DeviceNet						
	Interbus-S						
	Modbus Plus						
	Profibus-DP/S						
	Profibus-DP/M						

	0	1	2	3	4	5	6
Slot 2 Extension card	without						
	CAN-2						
	DeviceNet						
	Interbus-S						
	Modbus Plus						
	Profibus-DP/S						
	Profibus-DP/M						

Bus System Standard: Ethernet, 2x CANopen, Modbus

Hardware Standard: Compactflash-Slot

(1) With activated Profibus-DP-IC the Modbus is without function

4. Safety instructions

- **Electronic devices are not totally fail-safe**
- **Only properly qualified personnel are permitted to perform activities such as transport, installation, commissioning and maintenance. Properly qualified persons are those who are familiar with the transport, assembly, installation, commissioning and operation of the product, and who have the appropriate qualifications for their job. The qualified personnel must know and observe:
IEC 364 and CENELEC HD 384 or DIN VDE 0100
IEC-Report 664 or DIN VDE 0110
National Accident Prevention Regulations or BGV A2**
- **Read this documentation before carrying out installation and commissioning. Incorrect handling of the control system can lead to personal injury or material damage. It is vital that you keep to the technical data and information on connection requirements (on the nameplate and in the documentation).**
- **The control contains electrostatically sensitive components which may be damaged by incorrect handling. Discharge your body before touching the control. Avoid contact with highly insulating materials (artificial fabrics, plastic film etc.). Place the control on a conductive surface.**
- **Keep all covers and switchgear cabinet doors closed during operation. Otherwise there are deadly hazards, with the possibility of severe danger to health or material damage.**
- **Never undo the electrical connections to the control while it is live. There is a danger of electric arcing with damage to contacts and danger to persons.**
- **Note: This device contains a lithium-battery.
Possible dangers: Fire, explosion and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate or expose contents to water.**

5. European directives and standards

PMCprimo-controls are components which are intended to be incorporated into electrical plants and machines for industrial use.

When the controls are built into machines or plants, the intended operation of the control is forbidden until it has been established that the machine or plant fulfills the requirements of the EC Directive on Machines (98/37 EC) and the EC Directive on EMC (89/336/EEC). EN 60204 and EN 292 must also be observed. The PMCprimo 16+ complies the product standard EN61131-2 "programmable controllers".

The manufacturer of the machine or plant is responsible for ensuring that they meet the limits which are required by the EMC regulations. Advice on the correct installation for EMC - such as shielding, grounding, arrangement of filters, treatment of connectors and the laying out of cabling - can be found in this documentation.

- **CE- conformance**

Conformance with the EC Directive on EMC 89/336/EEC and the Low Voltage Directive 73/23/EEC is mandatory for the supply of controls within the European Community.

The controls of the PMCprimo-motion control series have been tested by an authorized testing laboratory in a defined configuration with the system components which are described in this documentation. Any divergence from the configuration and installation described in this documentation means that you will be responsible for the performance of new measurements to ensure that the regulatory requirements are met.

- **UL and cUL- conformance (I. quarter 2004)**

UL (cUL)-certified controls (Underwriters Laboratories Inc.) fulfil the relevant U.S. and Canadian standard (in this case UL 840 and UL 508C).

This standard describes the fulfillment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire, electric shock, or injury to persons, being caused by such equipment. The technical conformance with the U.S. and Canadian standard is determined by an independent UL (cUL) fire inspector through the type testing and regular check-ups.

Apart from the notes on installation and safety in the documentation, the customer does not have to observe any other points in direct connection with the UL (cUL)-certification of the equipment.

UL 508C

UL 508C describes the fulfillment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire being caused by such equipment.

UL 840

UL 840 describes the fulfillment by design of air and insulation creepage spacings for electrical equipment and printed circuit boards.

Note:

Based on the guideline 94/9/EC (ATEX guideline) this product is not suitable for the application in potential explosive areas without evaluation of the conformity.



6. Abbreviations and symbols

The abbreviations used in this manual are explained in the table below.

Abbr.	Meaning
CAN	Controller area network- network system
CAN-GND	Ground CAN bus
CE	Communauté Européenne
CNC-GND	Ground PLC/control
COM	Serial interface for a PC-AT
DGND	Digital ground, extern (for digital I/O, encoder)
DIN	Deutsches Institut für Normung
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge
GND	Analog ground, internal (CPU)
IEC	International Electrotechnical Commission
MODBUS	Serial protocol for panels
RS232	Serial interface, full duplex,
RS422	Serial interface, full duplex, differential
RJ-45	Interface for network connections (10BaseT)
SPS	Speicherprogrammierbare Steuerung
SSI	Synchron serial interface
UL	Underwriter Laboratory
V AC	AC voltage
V DC	DC voltage
VDE	Verein deutscher Elektrotechniker

	danger to personnel from electricity and its effects
	general warning mechanical hazard
	general instructions
⇒ page	see page (cross reference)
•	special emphasis

7. General

7.1. About this manual

This manual describes the digital control system PMCprimo 16+.

Here you can find information about:

- Technical data from page 14
- Assembly and installation from page 16
- Interfaces from page 26
- Commissioning from page 48
- Error diagnostics from page 50



The programming of the PMCprimo-motion control-systems is described explicitly in the PMCprimo programming manuals:

- for standard programming: PMCprimo programming manual
- for IEC-61131-3 programming by CoDeSys: user manual for PMCprimo SoftPLC

Useful hints about linking controls and CANopen devices via CAN bus can be found in the manual „PMCprimo CAN network“.

Both manuals are part on the CD-ROM “Motion Control Tools”.

7.2. Requirements

This manual makes the following demands on qualified personnel:



- Transport:** only by personnel with knowledge in handling electrostatically sensitive components.
- Installation:** only by electrically qualified personnel
- Commissioning:** only by personnel with extensive knowledge of electrical engineering technology

7.3. Prescribed use (Use as directed) of the control

The controls are components which are built into electrical equipment or machines, and can only be commissioned as integral components of such equipment.

The controls may only be operated in a closed switchgear cabinet, taking into account the ambient conditions defined on page 15.

7.4. Instrument description

7.4.1. Scope of delivery

When you order a PMCprimo 16+ from us, you will receive:

- PMCprimo 16+
- Mating connectors X3, X4, X5, X6
- Installation manual
- Software package CD-ROM "Motion Control Tools"
- PMCprimo programming manual as well as further documentations in PDF format on CD-ROM

7.4.2. Accessories

The following accessories have to be ordered separately, if required:

- Encoder cable
- MODBUS panel and MODBUS cable
- Ethernet cable (10-BaseT)
- Fieldbus module (see type key)
- CAN cable
- Communications cable to the PC (null modem cable)
- Software keys for Motion Generator and Soft-PLC
- Compact-Flash cards (type I or II)

7.4.3. The digital control “PMCprimo 16+”

7.4.3.1. Performance data

- Position controller with 1 ms cycle time
- 20 axes in system: 18 real axes (8/16 digital with CAN + 2 analog) + 2 virtual axes
- Each channel can operate in virtual motor mode
- Software gearbox with mapping
- Software differential and clutch
- Internal map generation (*motion generator*) as an option
- Product referencing
- Tension control
- 16 cam - free programmable
- Soft positioning („S“-ramps)

7.4.3.2. Fieldbus modules

- CAN bus with 500 kBit/s or 1 MBit/s(CANopen) – connecting up to 60 PMCprimo-motion control -systems
- 2. CAN for interfacing CANopen devices like panels, encoders, I/O modules
- Digital demand signals for the PMCTendo DD4 amplifier series via CAN
- MODBUS interface – connection possibilities for operator panels
- Ethernet interface (100 Mbit)
- Fieldbus interface: Profibus DP (slave + master), Interbus S, DeviceNet (option)

7.4.3.3. Interfaces

- 16 digital inputs, 24 V, electrically isolated (EN 61131-2)
- 16 digital outputs, 24 V, short circuit protected and electrically isolated (EN 61131-2)
- 2 analog outputs with ± 10 V range (demand signals)
- 2 analog inputs with ± 10 V input range

7.4.3.4. Soft-PLC CoDeSys® (option)

- Soft-PLC CoDeSys® (3S company)
- Fully PLC functionality specified in IEC 61131-3
- PLC and PMCprimo-combined in one system
- Programming system according to IEC 61131-3

7.4.3.5. Power supply

- 24 V power supply for CPU and peripheral
- 24 V power supply I/O
- Common power supply for all encoders

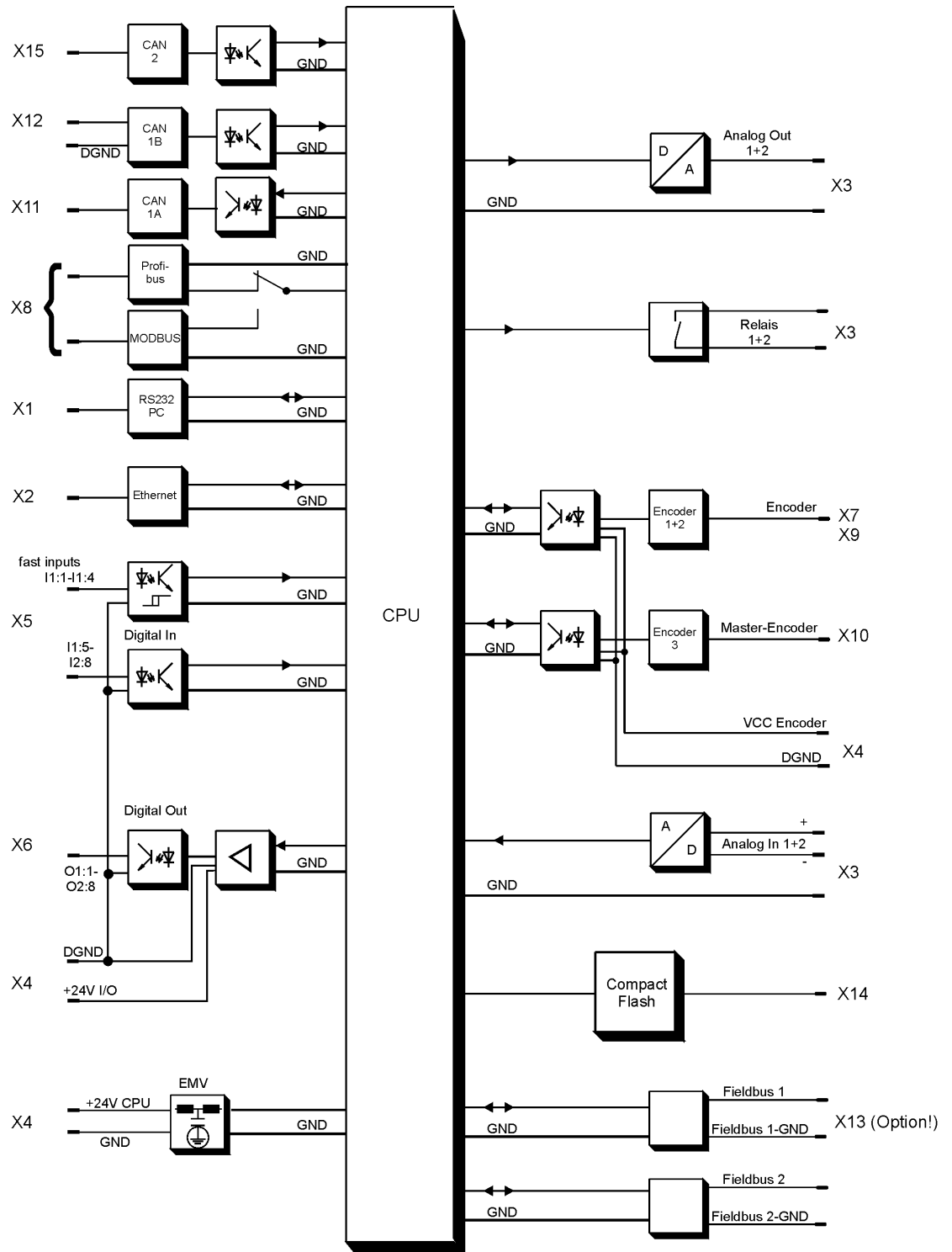
7.4.3.6. Operation and programming

- Comfortable programming with the software package “Motion Control Tools”. Fully programmable with any ASCII-Terminal.

7.5.

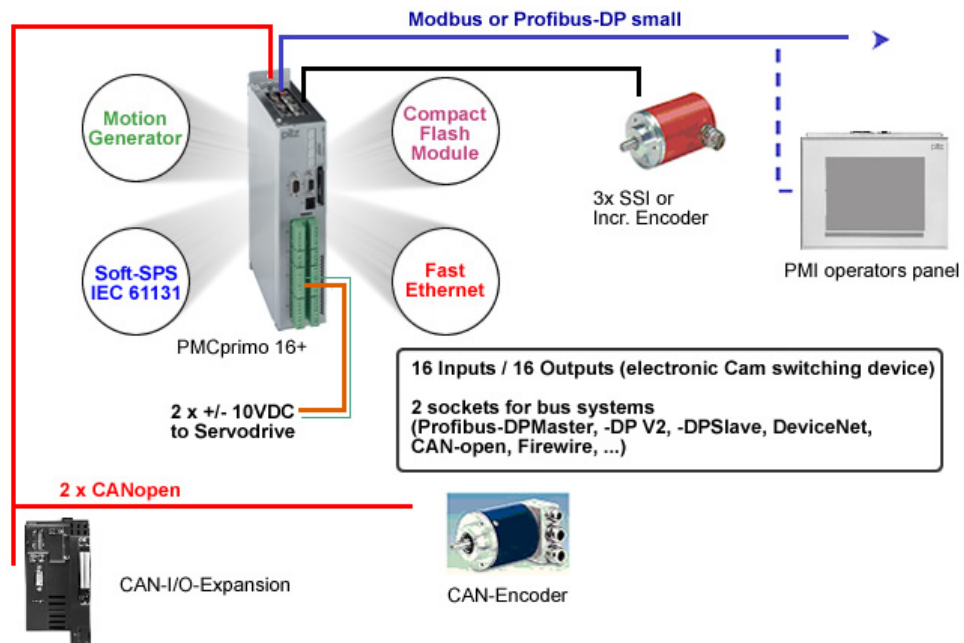
Block diagram

Overview: All I/O signals.

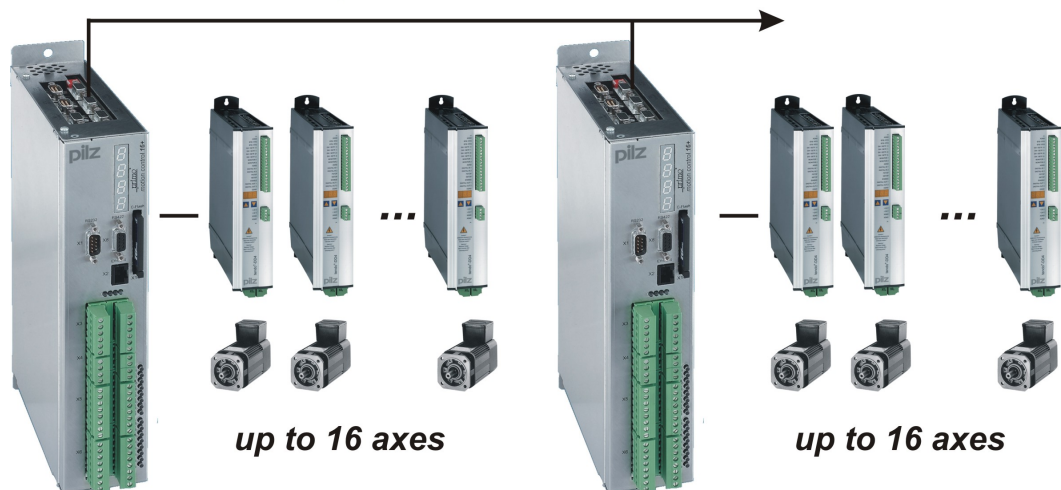


7.6. Example of use

PMCprimo 16+ Basic configuration:



PMCprimo 16+ - networked



7.7. Technical data

		PMCprimo 16+
Rated data	DIM	
Supply voltage CPU	V=	24
Power dissipation (no load)	W	max. 16
Power supply I/O	V=	24
Power supply encoder	V=	5..24 V (external supply)
Power supply CAN		internal
Analog inputs (X3)		
Resolution	Bit	12
Voltage range (ref. to GND)	V	±10
Input resistance	kΩ	122
Digital inputs (X5)		
Reference inputs (X5 Pin 1-4)	V	low 0...11 / high 11...24
Inputs (X5 Pin 5-16)	V	low 0...11 / high 11...24
Encoder inputs (X7, X9, X10)		
Input resistance	Ω	400
Transfer rate (max.)	MHz	1
Pulse width (Z track incremental encoder)	ns	min. 200
Frequency SSI-Clock	kHz	100/300
Signal level	V	5 (TTL)
Analog outputs (X3)		
Resolution	Bit	12
Voltage range (ref. to GND)	V	±10
Output resistance	Ω	170
max. output current each channel	mA	10
Digital outputs (X5)		
Output resistance	Ω	<1
max. output current each output	mA	100
Supply current		
24 V CPU	mA	max. 700
24 V I/O, each inputs, no load	mA	20
Supply current encoder	-	see encoder datasheet
12V supply CAN, each node	mA	10 per node
Connections		
Power supply (X4)	—	Combicon 5,08 / 4 pole , 2,5mm ²
Analog I/O (X3)	—	Combicon 5,08 / 6 pole , 2,5mm ²
Digital I/O (X5, X6)	—	Combicon 5,08 / 8 pole , 2,5mm ²
Ethernet (X2)	—	RJ45 plug (10 Base T)
RS232 (X1), CAN Out (X11)	—	SUB-D 9pole (plug)
MODBUS (X8), encoders (X7,X9,X10)	—	SUB-D 9pole (socket)
CAN In (X12)	—	SUB-D 9pole (socket)
Mechanical		
Weight	kg	2
Height without connectors	mm	317
Width	mm	64
Depth without connectors	mm	185

7.7.1. Permissible ambient conditions, ventilation, mounting position

	PMCprimo 16+
Storage temperature, -humidity, -duration	—25...+55°C, max. 20K/hour rate of change rel. humidity max. 95 %, no condensation (⇒ page 55)
Supply voltage tolerances Supply voltage CPU Supply voltage I/O Supply voltage encoder Supply voltage CAN	24 V DC (-10% +15%) 24 V DC (-10% +15%) see datasheet (with 5 V supply: -0%!) 12 V DC (-0% +15%), for long cables check voltage drop!
Ambient temperature in operation	0...+45°C
Humidity in operation	rel. humidity 95%, no condensation
Pollution level	Pollution level 2 to VDE0100
Enclosure protection	IP 20
Overvoltage category	II
Max. positioning level	3000m
Mounting position	generally vertikal. ⇒ page 17
Vibration	Please contact our applications department!
Ventilation	convection
Make sure that there is sufficient forced ventilation within the switchgear cabinet!	

7.7.2. Conductor cross-sections

We recommend for PMCprimo 16+:

Encoder	10x0,14 mm ² twisted pairs, shielded, capacitance <120pF/m
Analog in- and outputs	0,25 mm ² , twisted pairs, shielded
Digital I/O	0,5 mm ²
Serial I/O (RS232, MODBUS, CAN)	6x0,14 mm ² , shielded
Power supply, ground	max. 2,5 mm ² , check voltage drop!

7.7.3. LED-Display

A four character LED display shows the current status of each channel (⇒ page 51) after system power on.

Each error will be indicated with an error number (⇒ page 50).

7.7.4. Grounding system

GND	Ground for analog in-/outputs, RS232, MODBUS, internal voltages (CPU)
DGND	Ground for digital in-/outputs, 24 V I/O, encoder signals, CAN, optically and inductively isolated

The potential isolation is shown in the block diagram (⇒ page 12).

8. Installation

8.1. Important instructions



Read this instructions manual carefully.

Check the components supplied – do they match those ordered?

Protect the control from impermissible stresses. In particular, do not let any components become bent or any insulation distances altered during transport and handling. Avoid contact with electronic components and contacts.

The external fusing of the 24 V supply and the encoder supply is installed by the user.

Take care that the control is earthed properly. Do not use painted (non-conductive) mounting plates.



Route power and control cables separately. We recommend a separation of at least 20 cm. This improves the interference immunity required by EMC regulations.

Install all shielding with large areas (low impedance), with metallized connector housings or shield connection clamps where possible.

Ensure that there is an adequate flow of cool, filtered air into the bottom of the switchgear cabinet. See page 14.

The programming has to be done by qualified personnel only.



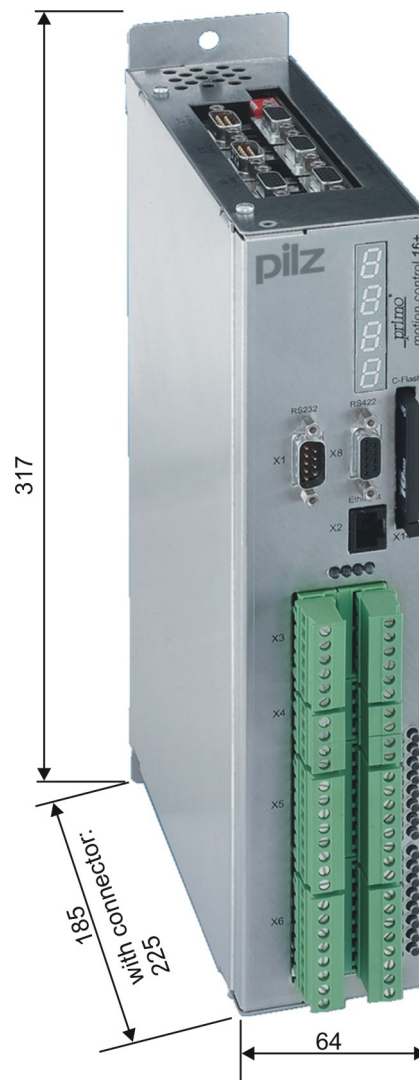
Caution

Never disconnect the electrical connections to the control while it is live. In un-favourable circumstances this could result in destruction of the electronics.

8.2. Assembly

8.2.1. Dimensions

- Dimension of the PMCprimo 16+ -housing (HxWxD) 317 x 64 x 185 mm
- Distance of mounting holes: 300 mm
- Diameter mounting holes: 8 mm

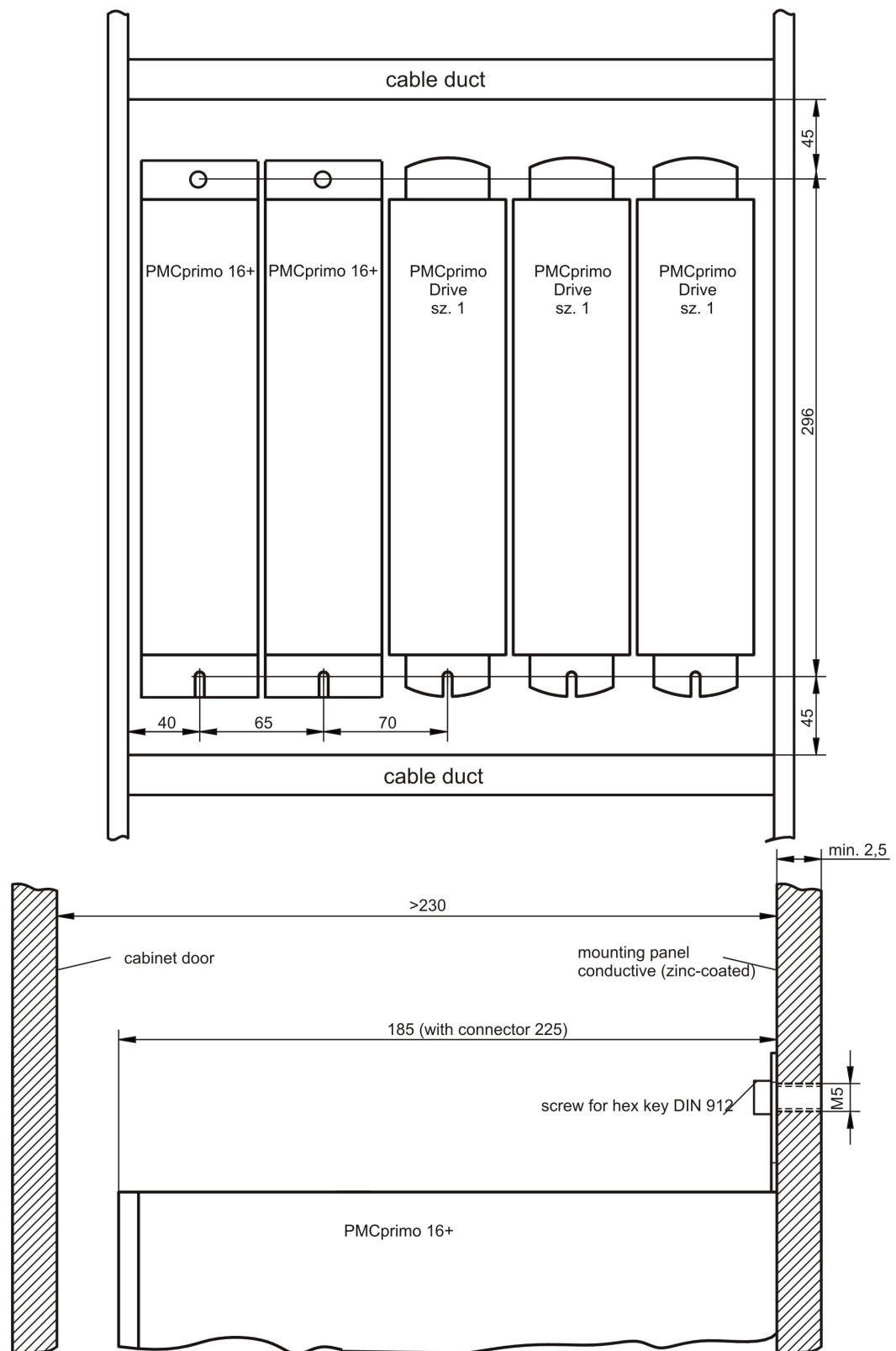


All dimensions in mm.

8.2.2. Assembly inside switch cabinet

Material: 2 hexagon socket screws DIN 912, M5

Tool required: 4 mm Allen key



8.3. Wiring

Only professional staff who are qualified in electrical engineering are allowed to install the control.

The installation procedure is described as an example. A different procedure may be sensible or necessary, depending on the application of the equipment.



Caution!

Only install and wire up the equipment when it is not live, i.e. when neither the mains power supply nor the 24 V auxiliary voltage nor the operating voltages of any other connected equipment is switched on.

Take care that the cabinet is safely disconnected (with a lock-out, warning signs etc.). The individual voltages will be switched on for the first time during commissioning.



Note !

The ground symbol $\perp$, which you will find in all the wiring diagrams, indicates that you must take care to provide an electrically conductive connection with the largest possible area between the unit indicated and the mounting plate in the switchgear cabinet. This connection is for the effective grounding of HF interference, and must not be confused with the PE- symbol $\oplus$ (a protective measure to EN 60204).



Use the following connection diagrams:

— Power supply:	page 26
— Shielding:	page 44
— Digital signals:	page 28
— Analog signal:	page 36
— Relay :	page 44
— Encoders:	page 39
— MODBUS / Profibus small interface:	page 41
— CAN bus interface:	page 44
— RS232 interface:	page 44
— Ethernet interface:	page 44
— Fieldbus interface:	page 48



The following notes should assist you to carry out the installation in a sensible sequence, without overlooking anything important.



Site

In a closed switchgear cabinet. Observe technical data on page 14.

The site must be free from conductive or corrosive materials.

For the mounting position in the cabinet ⇒ page 18.

Ventilation

Check that the ventilation of the control is unimpeded and keep within the permitted ambient temperature

Ventilation ⇒ page 14.

Keep the required space clear above and below the control ⇒ page 18.

Assembly

Assemble the control and power supply close together on the conductive, earthed mounting plate in the cabinet.

Cable selection

Select cables according to EN 60204 ⇒ page 15.

Grounding shielding

EMC-compliant shielding and grounding (⇒ page 21).
Earth the mounting plate, motor housing and CNC-GND of the controls.

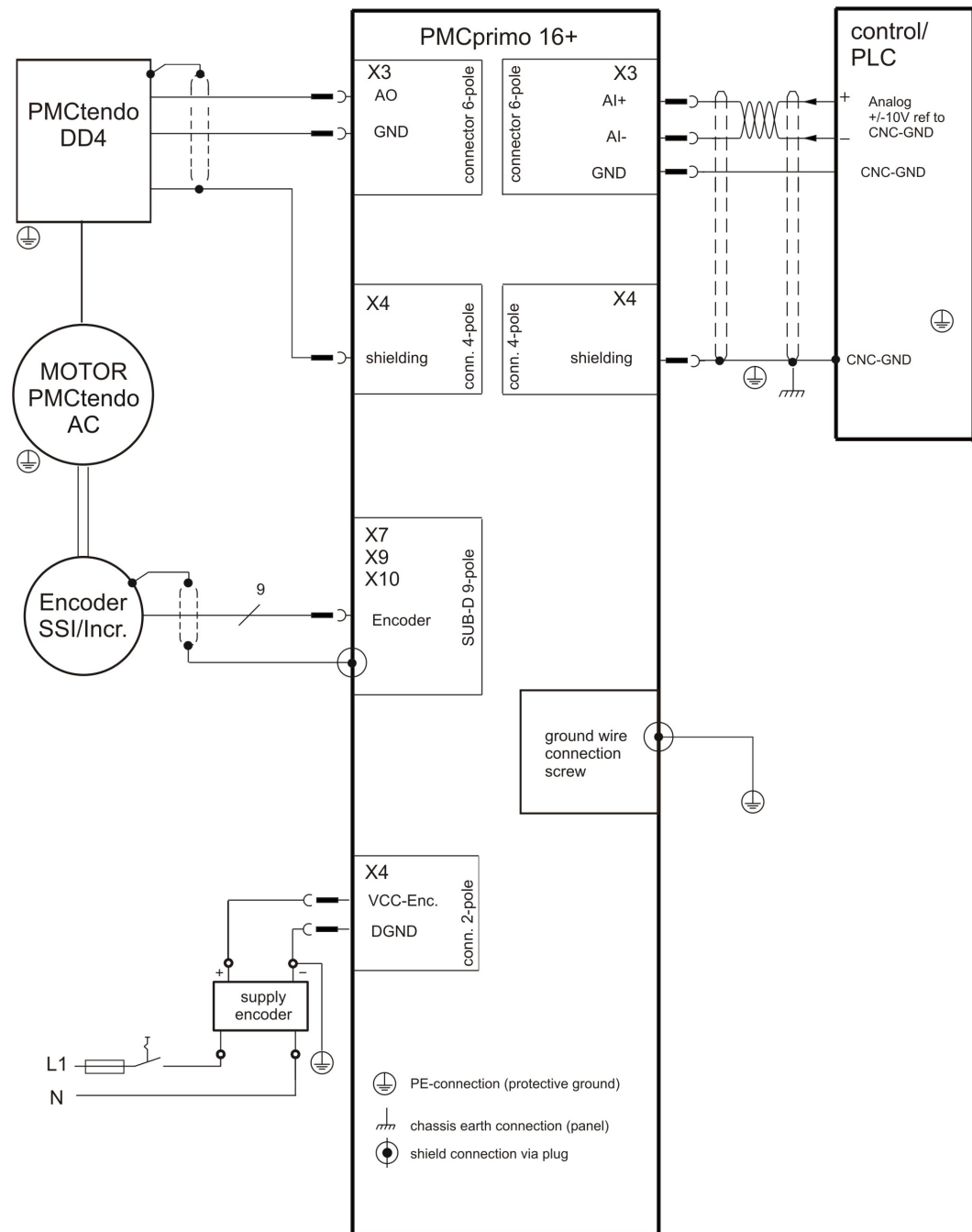
Wiring

- Route power leads and control cables separately.
- Wire the relay contacts in series into the safety loop of the installation.
- Connect the digital control inputs to the control.
- Connect DGND.
- Connect analog signals.
- Connect encoders.
- Connect 24 V I/O and encoder supply (for max. permissible voltage values ⇒ page 14).
- Connect 24 V CPU supply (for max. permissible voltage values ⇒ page 14).
- Connect PC (RS232/Ethernet) (⇒ page 30).

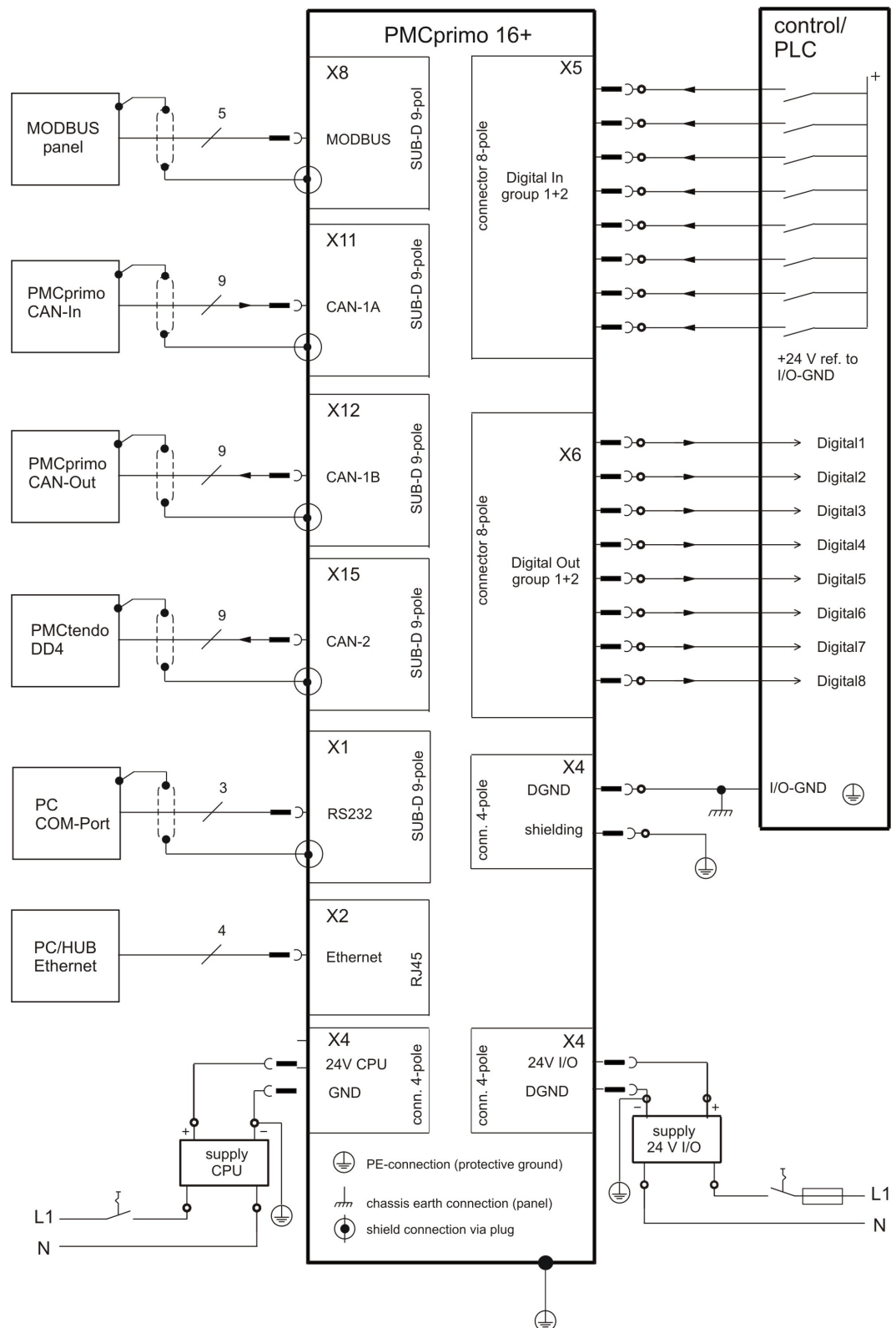
Final check

- Final check of the implementation of the wiring, according to the wiring diagrams which have been used.

8.3.1. Connection diagram – motors and encoders

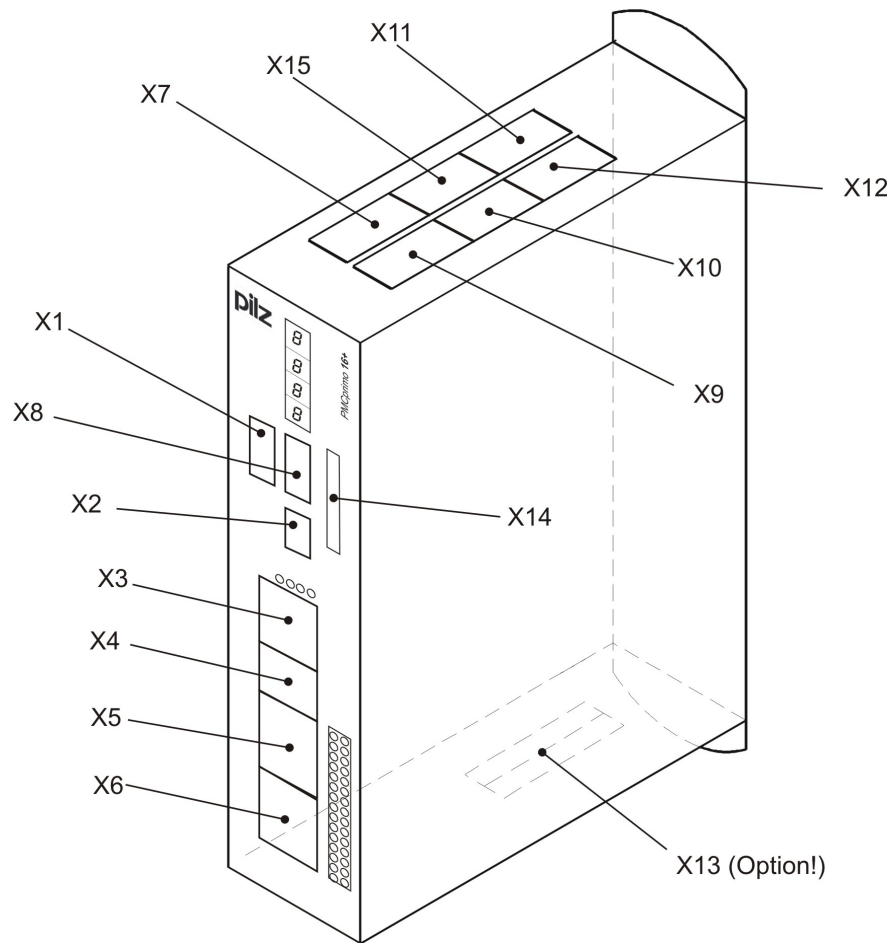


8.3.2. Connection diagram – digital I/O and communication



8.3.3. Pin assignments - overview

This overview shows the position of each connector:

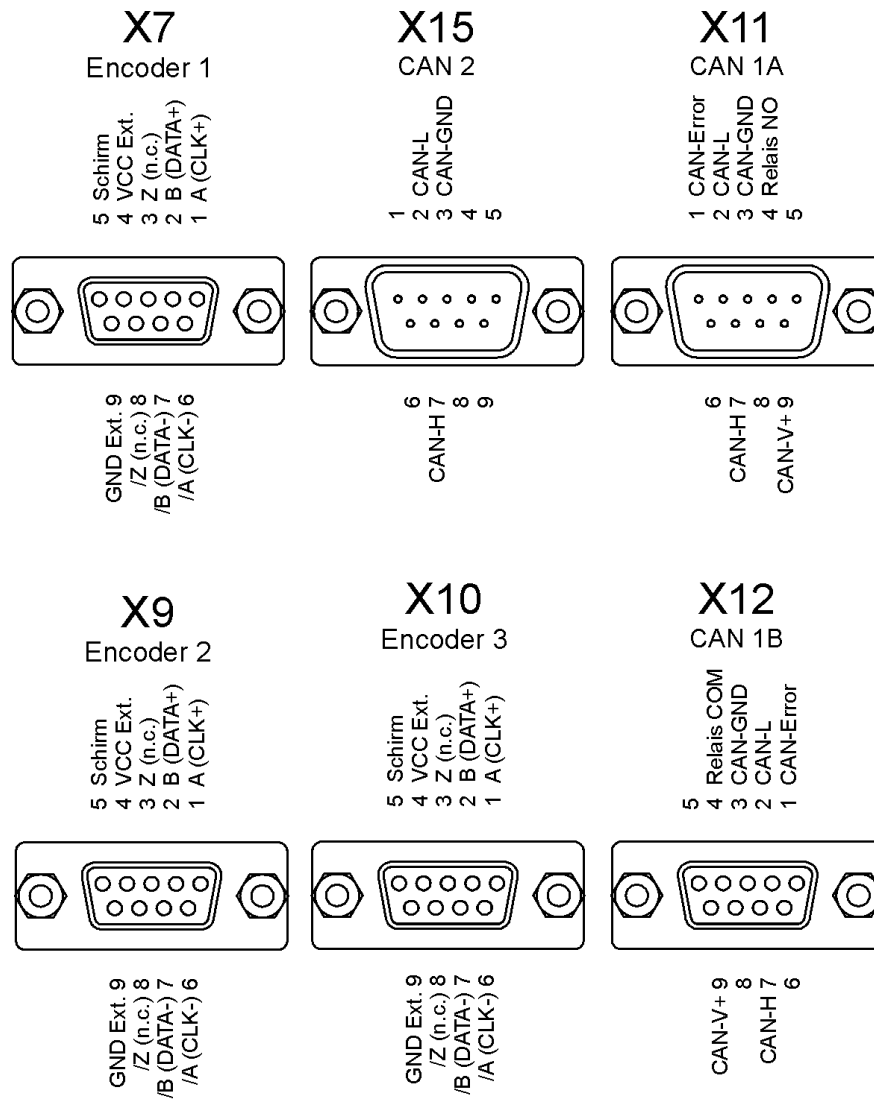
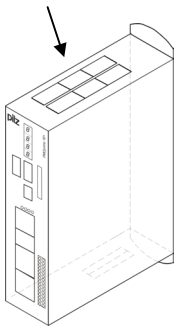


The connectors are described on following pages:

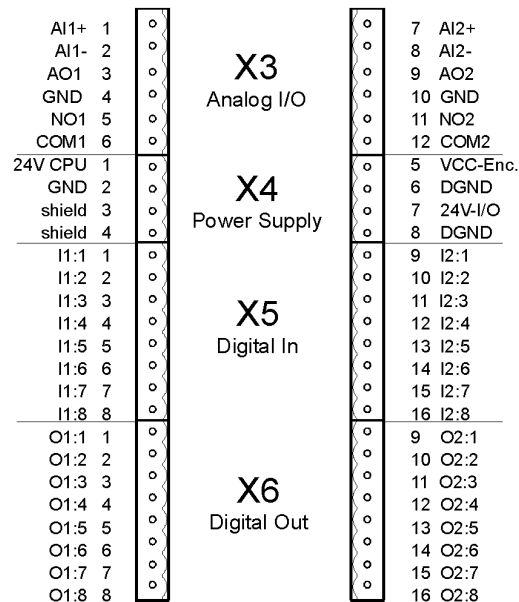
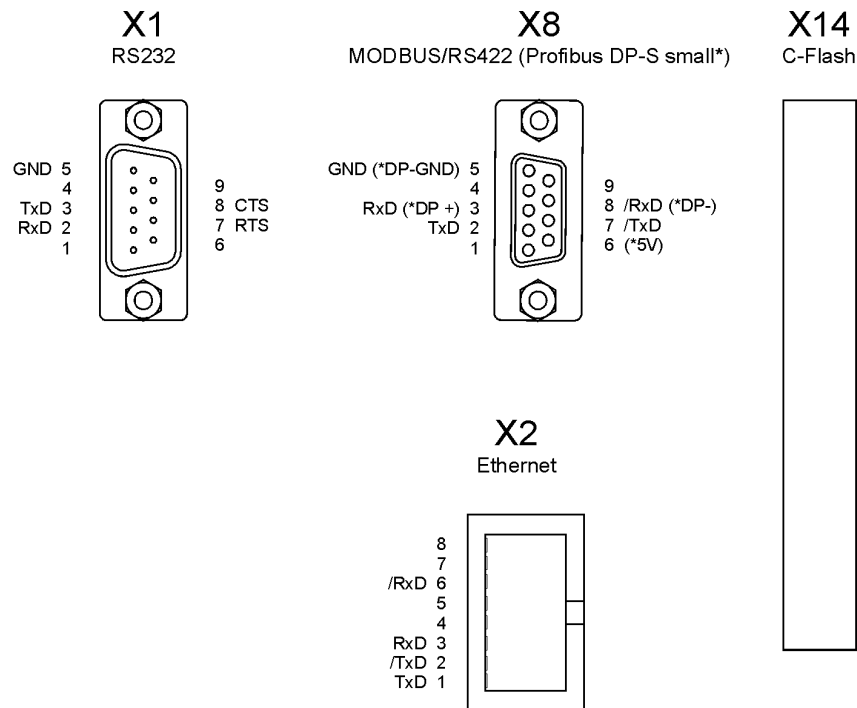
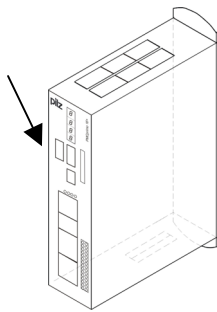
Connector	see page
X1 (RS 232)	page 30
X2 (Ethernet)	page 32
X3 (Analog I/O)	page 36
X4 (Power Supply)	page 26
X5 (Digital In)	page 34
X6 (Digital Out)	page 35
X7, X9, X10 (Encoder 1-3)	page 39
X8 (MODBUS / Profibus DP-S small)	page 42
X11, X12 (CANopen)	page 44
X13 (Fieldbus)	see *.pdf files on CD-ROM
X14 (CompactFlash-Card)	page 47
X15 (CAN-open)	page 46

Note: The description of the 7-segment-display can be found starting from page 51.
The description of the LED's can be found on page 33 and 38.

8.3.4. Pin assignments – top view



8.3.5. Pin assignments – front view

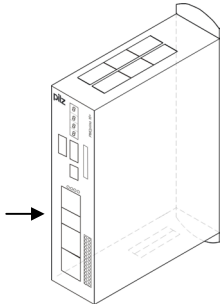


9. Interfaces

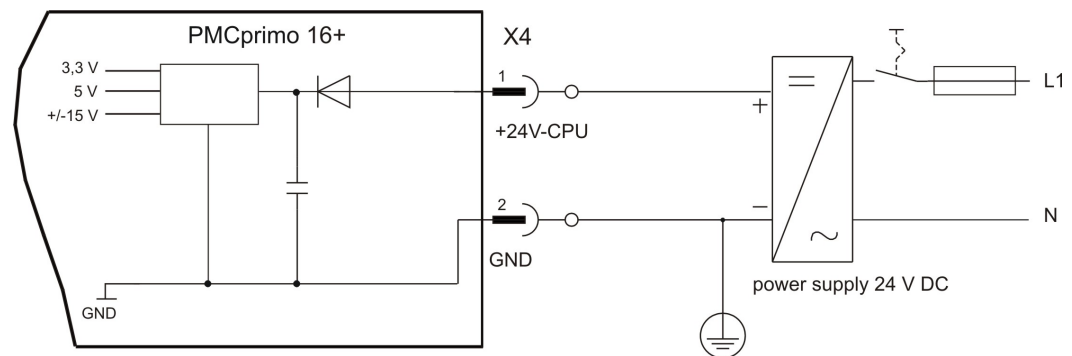
All important interfaces of the PMCprimo 16+ are shown in this chapter. The precise location of the connectors and terminals can be seen on page 24 and page 25.

9.1. Power supply

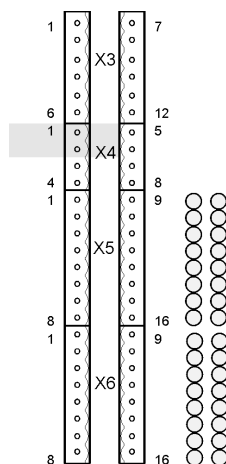
9.1.1. CPU power supply 24V



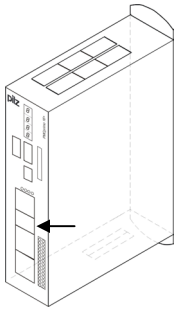
- Connector X4 Pin 1+2
- Power supply for CPU and integrated peripherals
- Supply from an external 24V DC-power supply
- Required current rating: ca. 0,7 A (see page 14)
- Reference ground is GND (analog GND)
- External fuse protection by the user
- Integrated EMC filters
- **See important notes to commissioning** (see page 50)



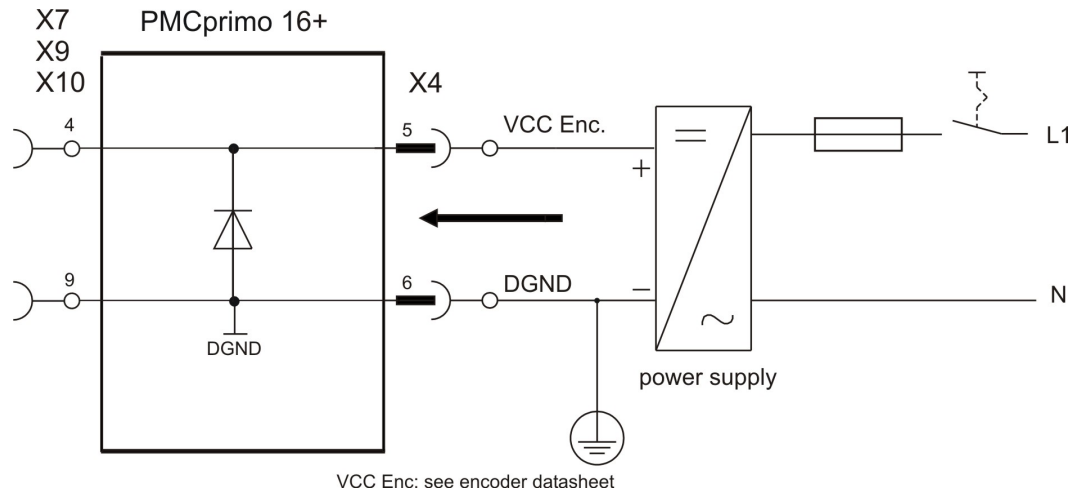
Pin	Description
1	24 V/0,7 A DC
2	0 V (analog ground)



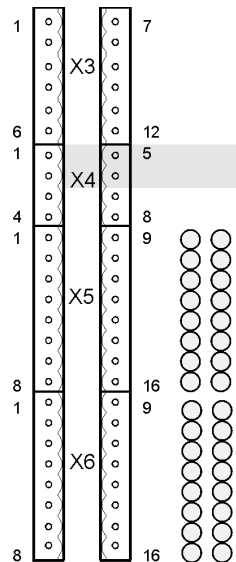
9.1.2. Encoder power supply



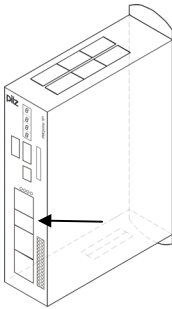
- Connector X4 Pin 5+6
- Common power supply for all connected encoders
- Voltage range: See encoder datasheet
- Reference ground is DGND (Digital-GND)
- External fusing provided by the user



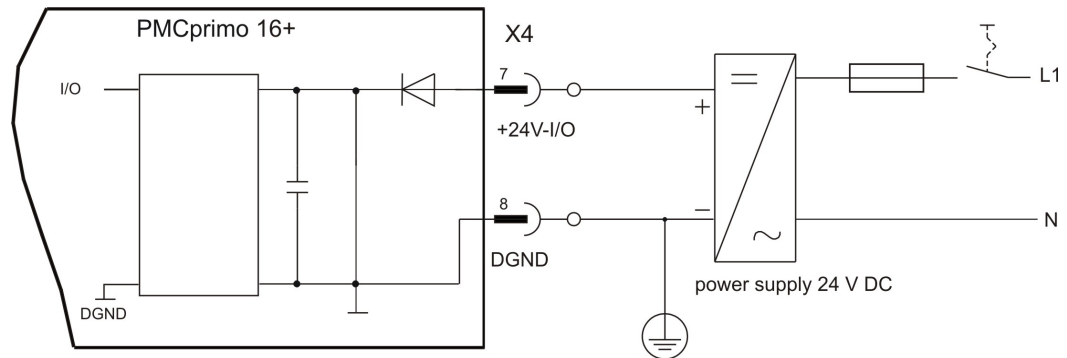
Pin	Description
5	5 – 24 V DC (according to the encoder type)
6	0 V (digital ground)



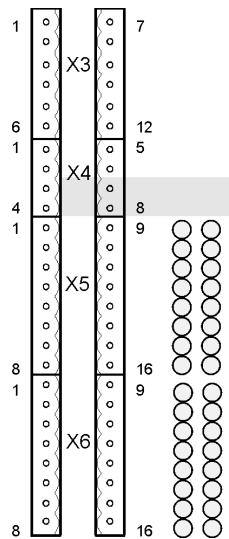
9.1.3. Digital I/O power supply



- Connector X4 Pin 7+8
- Power supply for the digital I/O
- Supply from an external 24V DC-power supply
- Required current rating depends from load on outputs (see page 14)
- Reference ground is DGND (Digital-GND)
- External fusing provided by the user

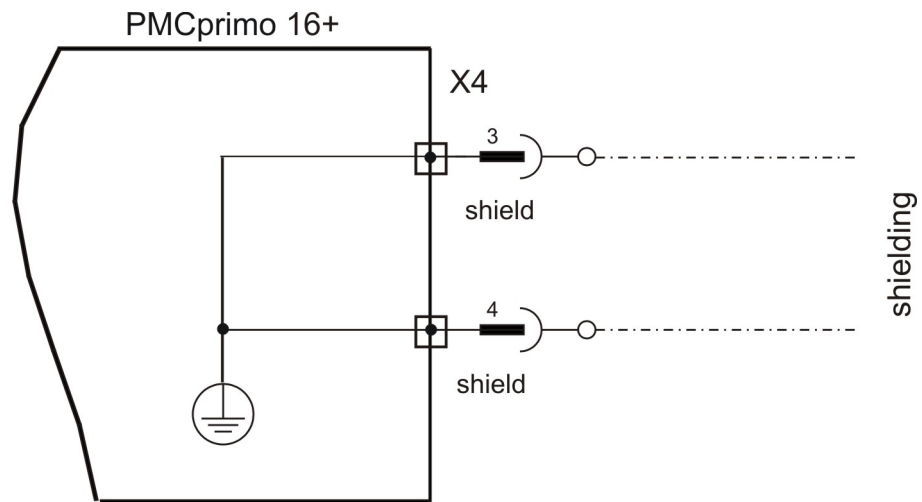
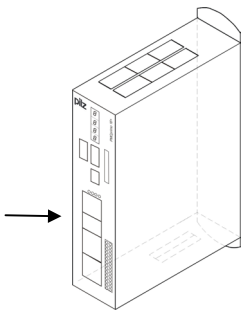


Pin	Description
7	24 V DC
8	0 V (digital ground)

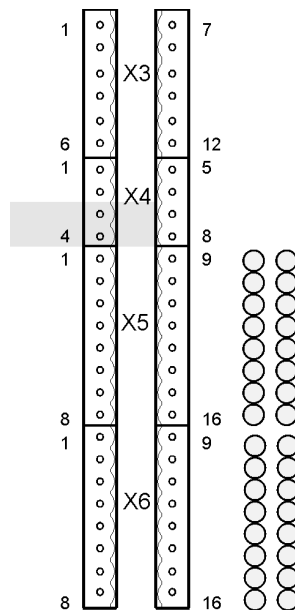


9.1.4. Shielding

- Connector X4 Pin 3+4
- Shielding connectors are connectet with the housing
- For connection of cable shieldings (e.g. analog signals, encoder)



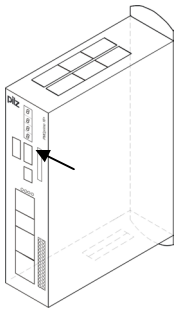
Pin	Description
3	Shielding
4	Shielding



9.2. Programming interfaces

9.2.1. RS-232 interface

9.2.1.1. General



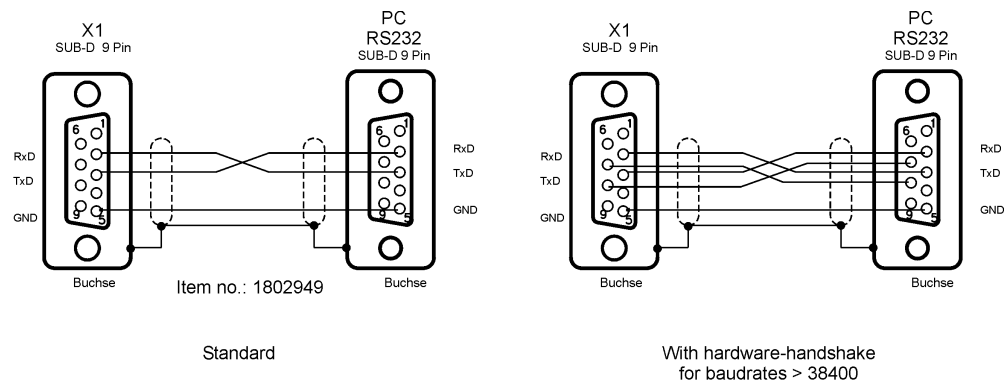
The programming of the PMCprimo 16+ is done with the terminal **PTerm** on a Personal Computer (PC) or Laptop.

PTerm is part of the "Motion Control Tools" and can be found on the enclosed CD-ROM.

Connect the RS232 interface (X1) of the PMCprimo 16+ via a normal cable to a free serial interface (COM1 or COM2) on the PC.

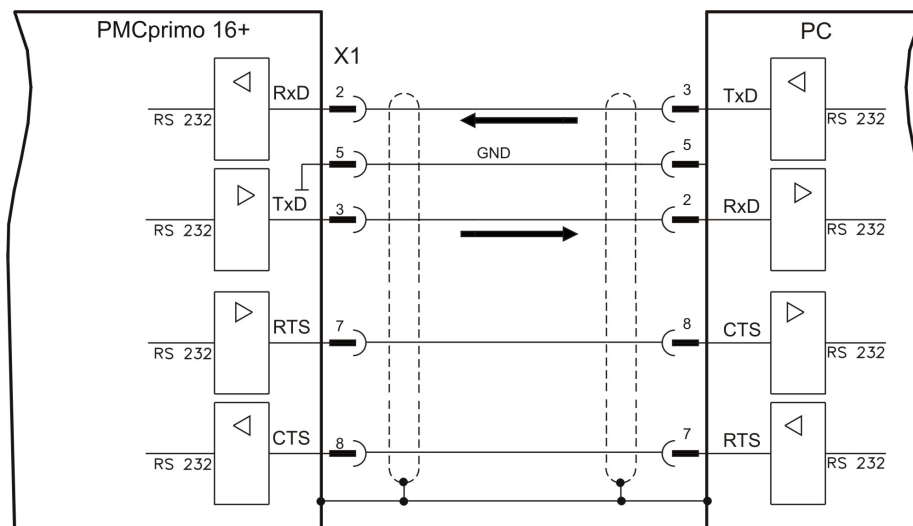
9.2.1.2. Pin assignment cable

(View: looking at the face of the built-in SUB-D connectors, this corresponds to the solder side of the SUB-D sockets on the cable)



Reference ground of the RS232 interface is GND (no galvanic isolation!).

Pin	Description
2	RxD (Receive data)
3	TxD (Send data)
5	GND (Reference ground)
6	RTS (Hardware-handshake, for > 38400 baud)
7	CTS (Hardware-handshake, for > 38400 baud)



9.2.1.3. Connection via RS232

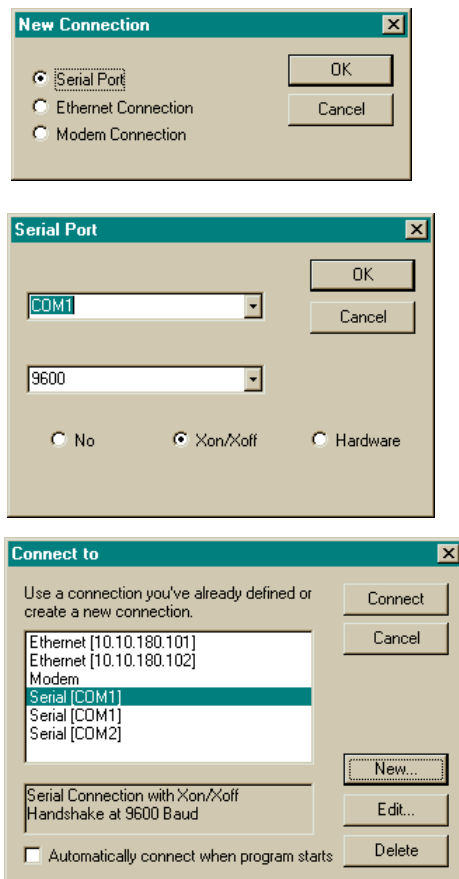
The following parameters are used (standard):

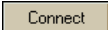
- 9600 Baud
- 8 data bits
- 1 stop bit
- No parity
- XOn/XOff-software handshake

With the command “**BD**” the communication rate can be changed (see PMCprimo programming manual).

The hardware handshake can additionally activated with the “**CD**” command. With this, transmittals up to 115200 baud are possible.

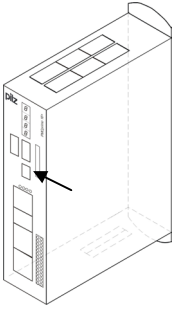
Set these parameters with **PTerm** (see **PTerm** programming manual):



After clicking on  the connection will be made and programming can be started.

9.2.2. Ethernet interface

9.2.2.1. General

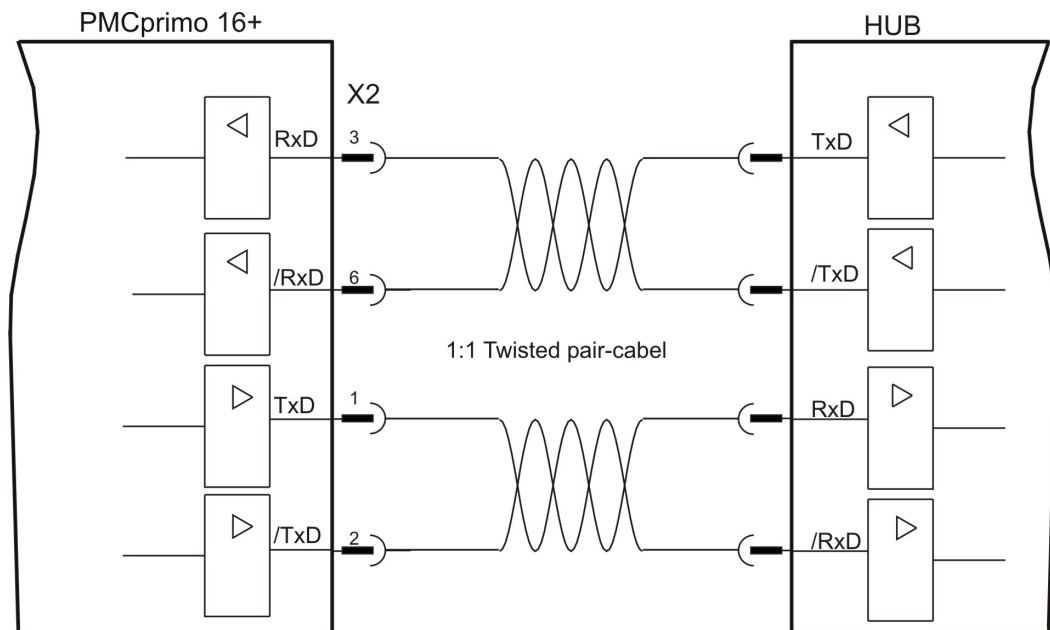


As a fast alternative to slow RS232-transmission PMCprimo 16+ provides an Ethernet interface (RJ-45-plug, X2).

With the terminal **PTerm** the control can be programmed with a data rate of 100 MBit/s.

The PMCprimo 16+ can easily be integrated in an existing Ethernet network.

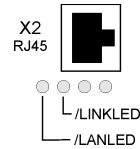
9.2.2.2. Interface



Note!

To connect a PC via Ethernet a cross linked cable (crossover) is needed.
The depicted cable is only for use with a HUB.

The two LEDs above the RJ45-plug indicate the actual status of the Ethernet transmission:



Yellow LED (/LANLED): Transmit/receive data

Green LED (/LINKLED): Connection to HUB/PC OK!

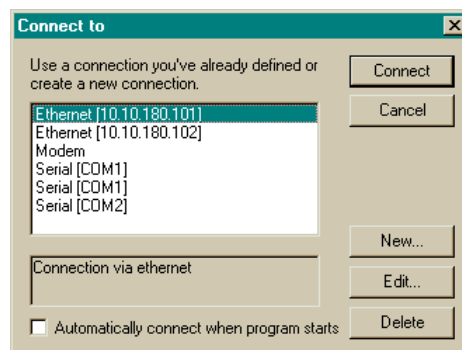
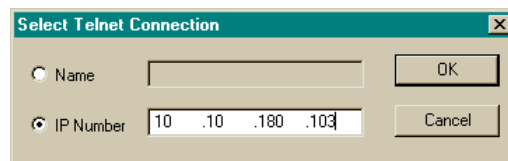
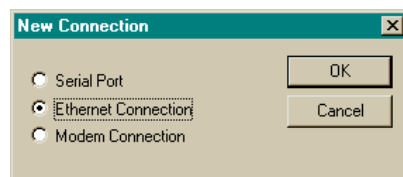
9.2.2.3. Setting the IP address

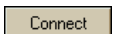
To communicate with the PMCprimo 16+ via Ethernet, the IP address of the control has to be set.

This will be done with the command “CD” (see PMCprimo programming manual):

```
0.1: cd
0.1:
Actual configuration:
Operate Mode: STANDALONE
Actual IP address 10.10.180.101
Actual Netmask 255.0.0.0
Fieldbus In/Out length 50 words
Change Operating Mode? Y/N: N
Delete application data? Y/N: N
Change Ethernet? Y/N: Y
New IP address (10.10.180.101) ? 10.10.180.101
New Netmask (255.0.0.0) ?
Change Ethernet? Y/N: N
Change Fieldbus configuration? Y/N: N
0.1:
```

Now you can connect with Ethernet using PTerm.



After clicking on  the connection will be made and programming can be started.

9.3.

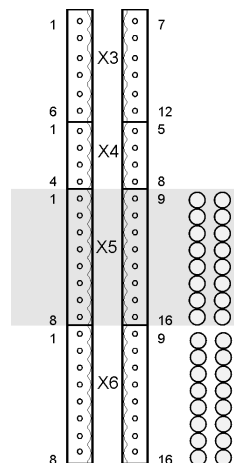
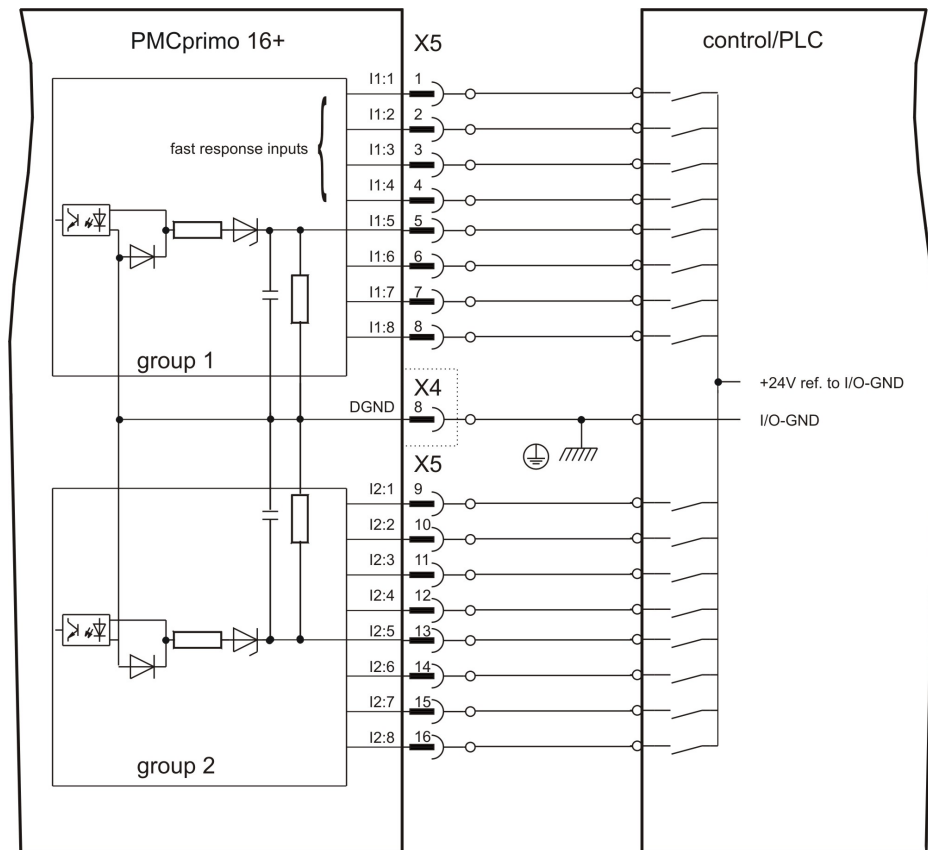
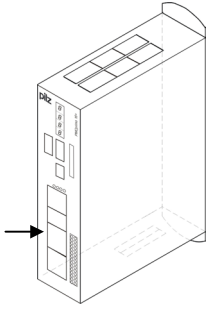
Digital signals

9.3.1.

Digital inputs I1:1 – I2:8

The digital inputs of the PMCprimo 16+ are electrically isolated through optocouplers.

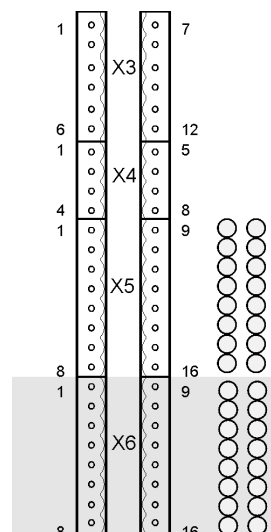
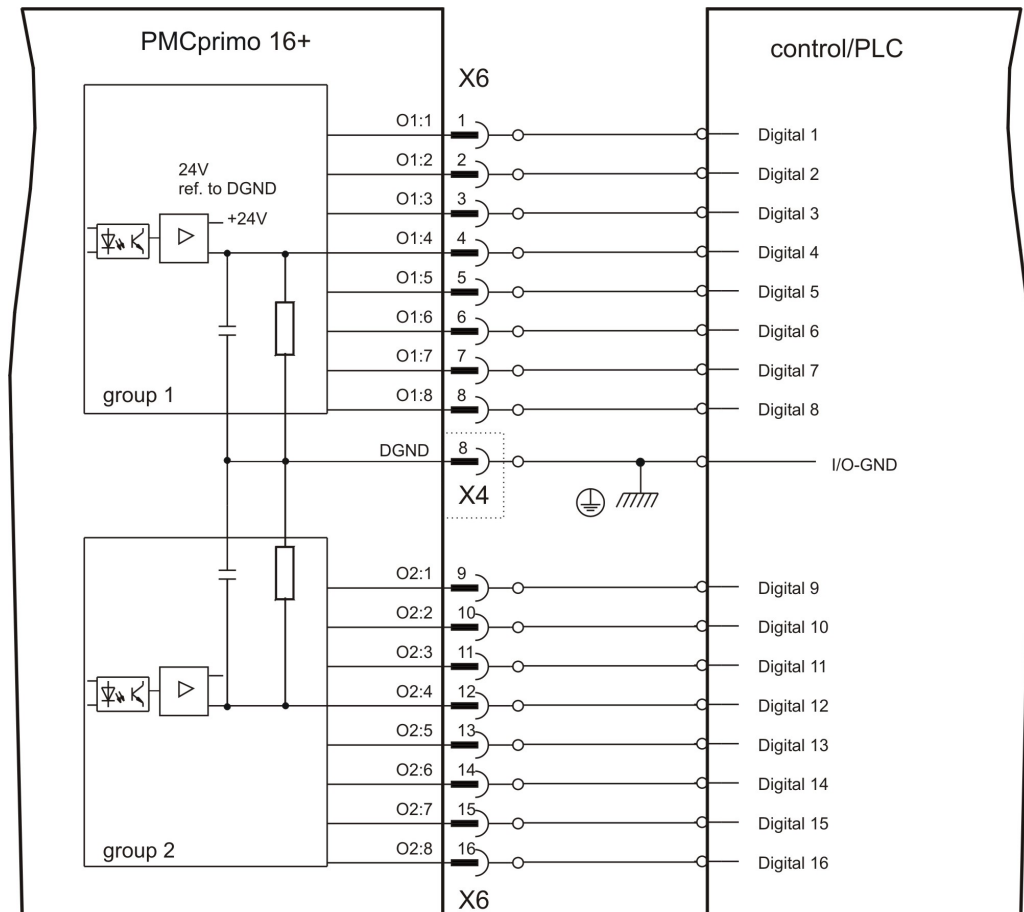
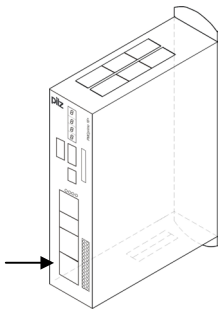
- Connector X5 Pin 1-16
- Reference ground is DGND (Digital-GND, connector X4, Pin 6+8)
- Input logic is PLC compatible (24V-level) according to EN 61131-2
- Logical high: +11..24V / logical low: 0 V .. 11 V
- Fast response inputs I1:1 - I1:4 for e.g. product referencing
- Actual input status is indicated through green LEDs



9.3.2. Digital outputs O1:1 – O2:8

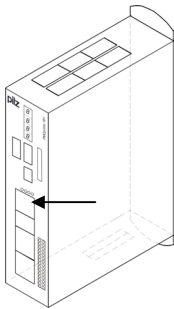
All digital outputs are electrically isolated and short circuit protected.

- Connector X6 Pin 1-16
- Reference ground is DGND (Digital-GND, connector X4, Pin 6+8)
- „High-Side“-outputs: 24V / 0,1 A each output
- Actual output status is indicated through red LEDs



9.4. Analog signals

9.4.1. Analog outputs AO1 and AO2

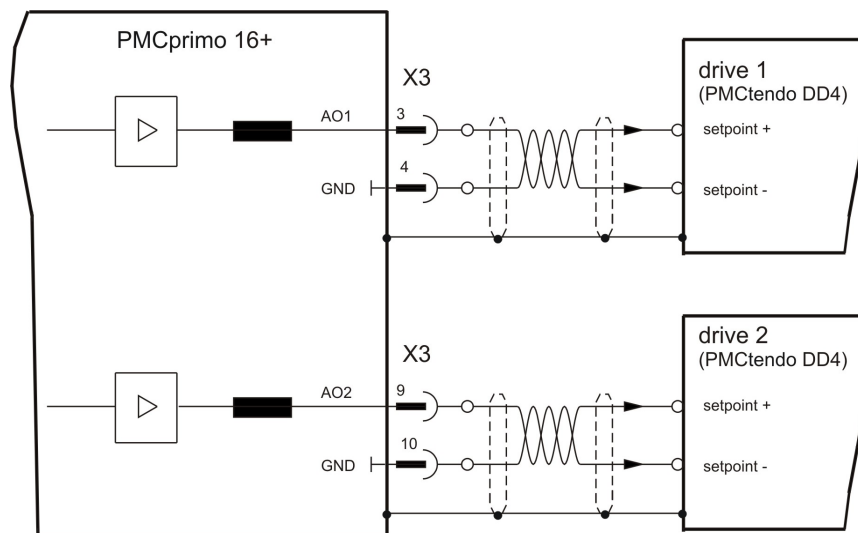


Both analog outputs of the PMCprimo 16+ are normally used as demand outputs for the connected servo amplifiers, e.g. Pilz PM Ctendo DD4.

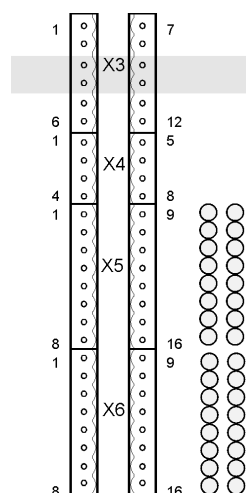
The demand output signals have a voltage range of ± 10 V.

The analog outputs can be configured as auxiliary outputs. With the commands **SF** and **AO** (see PMCprimo programming manual) you can monitor several signals, e.g. demand position error.

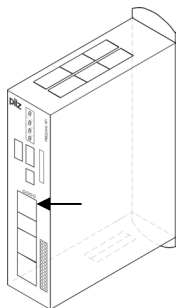
- Connector X3 Pin 3+9
- Reference ground is GND (analog-GND, connector X3 Pin 4+10)
- No galvanic isolation
- Voltage range: ± 10 V
- Resolution: 12 Bit (4096 voltage levels)



Pin	Description
3	AO1 (± 10 V)
4	0 V (analog ground)
9	AO2 (± 10 V)
10	0 V (analog ground)



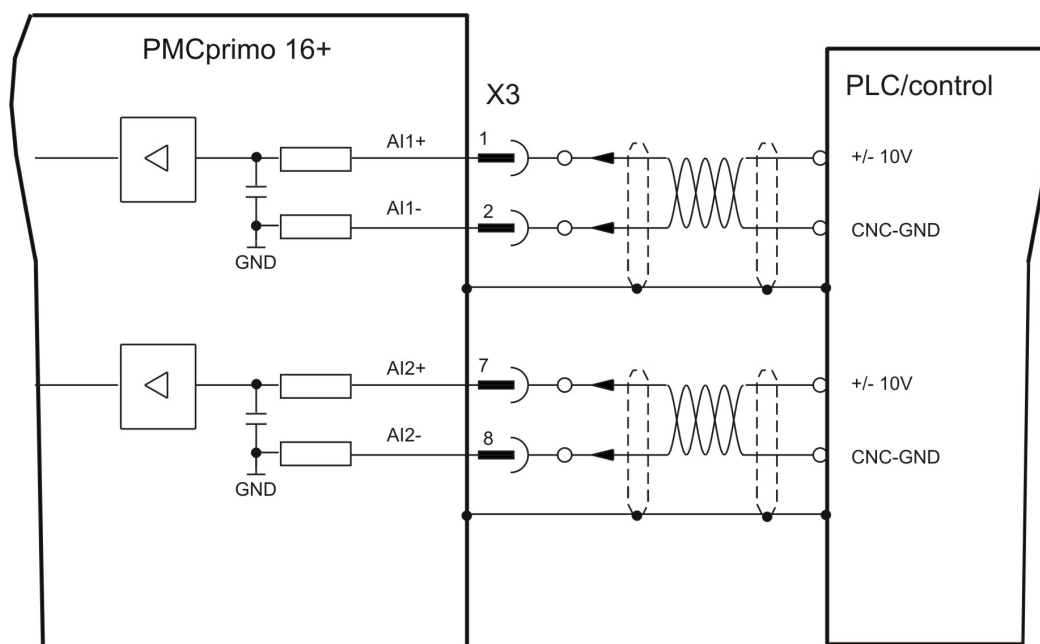
9.4.2. Analog inputs AI1 and AI2



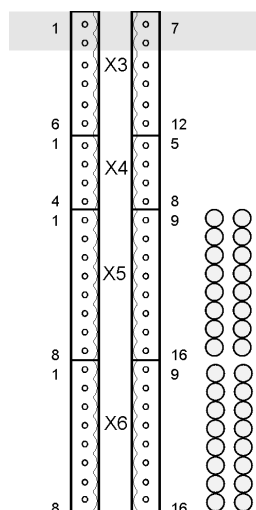
Both analog inputs of the PMCprimo 16+ are auxiliary inputs. They can be used e.g. for tension control.
The input voltage range is ± 10 V.

The current value of the analog input can be read with the command **DA** (see PMCprimo programming manual).

- Connector X3 Pin 1+2 and Pin 7+8
- All signals are referred to AI1- resp. AI2- (connector X3 Pin 2 resp. Pin 8)
- No galvanic isolation
- Input voltage range : ± 10 V (ref. to AI1-/AI2-)
- Resolution : 12 Bit (4096 voltage levels)

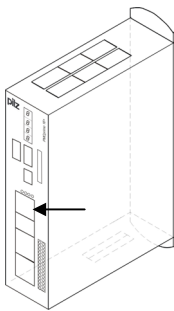


Pin	Description
1	AI1+ (± 10 V)
2	AI1- (Reference Ground for AI1+)
7	AI2+ (± 10 V)
8	AI2- (Reference Ground for AI2+)



9.5.

Relay outputs

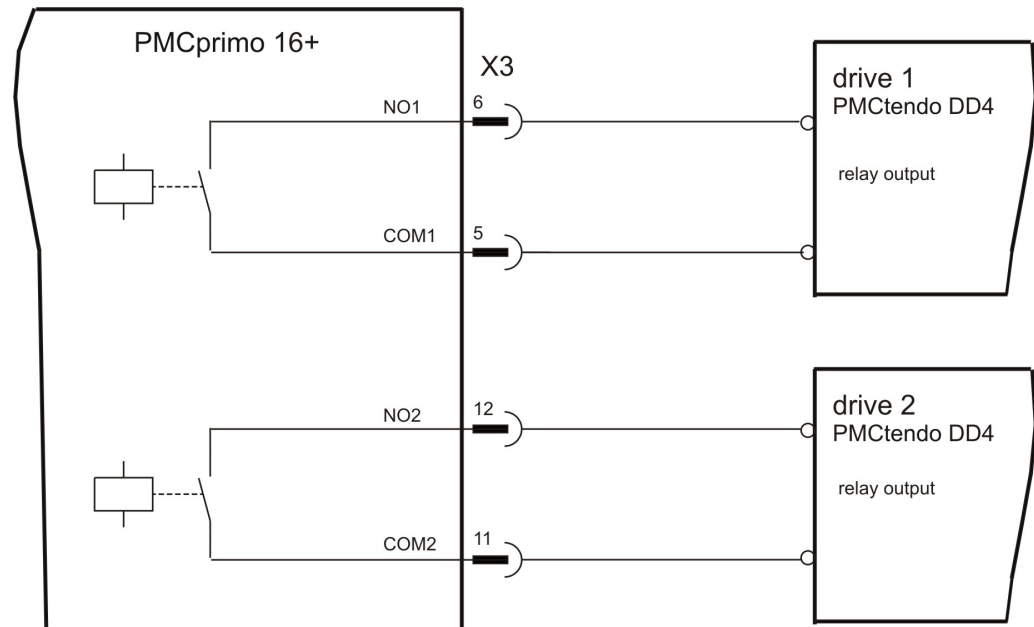


The relay contacts NO and COM (X3 Pin 5+6 and Pin 11+12) are used to derive an enable signal to the servo amplifier for channel 1+2.

The contacts are closed when position control on channel 1 or 2 are active (e.g. command **PC**).

A motor error opens the relay contact and sets the demand output signal to 0V.

Maximum load: Each contact 30V DC/1A.

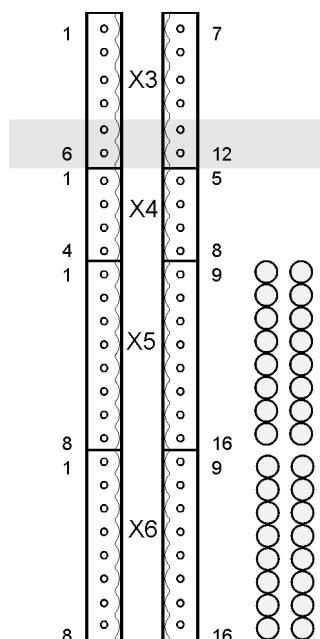
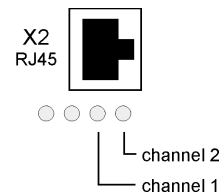


The red LEDs below the RJ45-plug X2 show the actual relay status:

LED on: Contact closed, position control active

LED off: Contact open, motor off state

Pin	Description
5	NO1 (Normal open 1)
6	COM1 (shared contact)
11	NO2 (Normal open 2)
12	COM2 (shared contact)



9.6. Encoder inputs

The PMCprimo 16+ is designed for use with up to three incremental or SSI encoders (X7, X9 and X10). The encoder type can easily be changed with the “**FS**” command.

With SSI encoders the number of data bits can be set with the “**NB**” command.

The logical sense of each encoder input can be changed with the command “**CW**”. Setting the direction bit reverses the direction of the encoder without wiring.

If a reference signal occurs, the actual encoder position is stored (see reference inputs page 34). This is useful for product referencing. For further details see PMCprimo programming manual.

A master encoder is normally connected at the encoder input of channel three. But with the “**FC**” command the encoder signals can be redirected to channel 1 or 2.

All encoders have a common power supply with connector X4 (Pin 5+6). See also page 27.

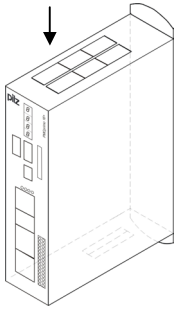


If encoders with different supply voltages should be connected, the encoder cables have to be modified. The two wires for supply voltage are connected with an external power supply (X7, X9, X10: Pin 4+9).

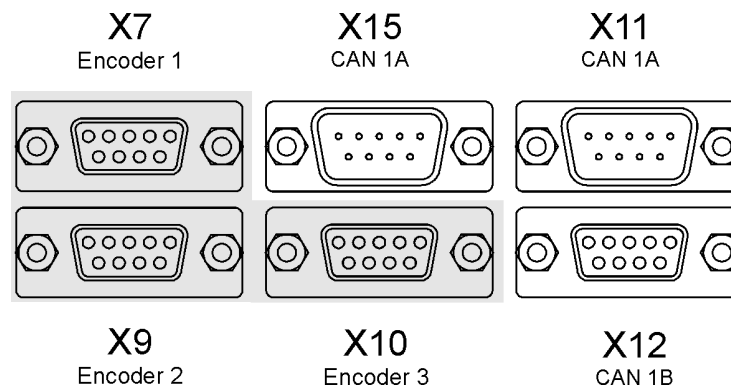
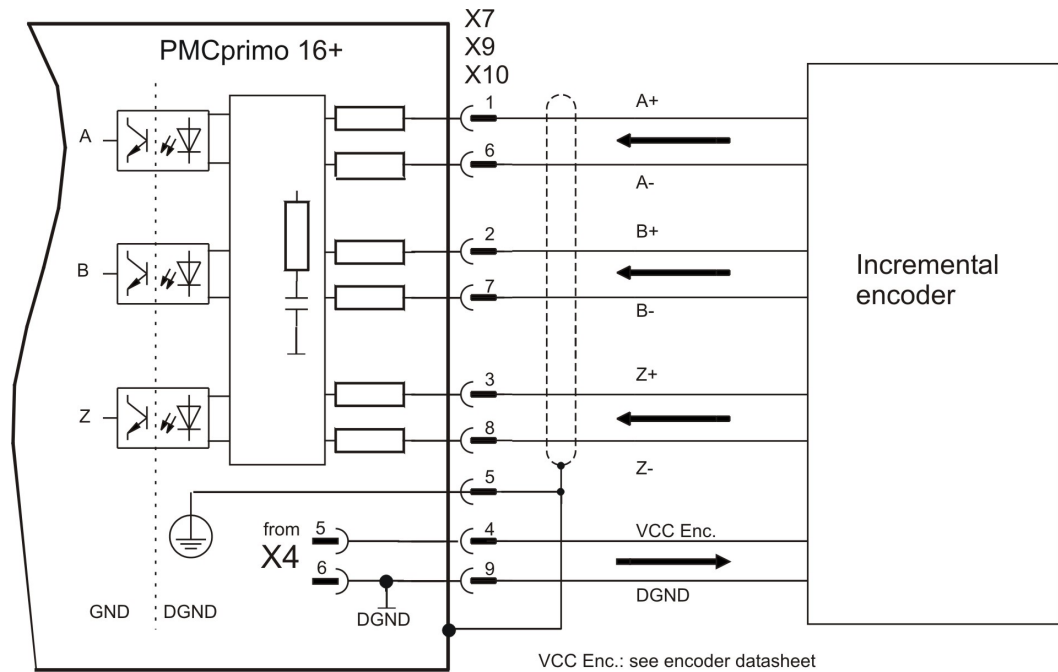


The input configuration is designed for 5 V logic level. Exceeding this range will damage the input logic.

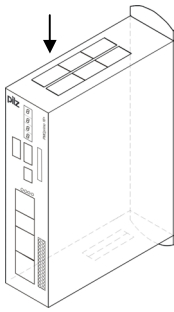
9.6.1. Incremental encoder



- Reference ground is DGND (connector X4 Pin 6 + 8)
- For encoders with differential line drivers – track A, B and Z (0-Index)
- Quadrature encoder x1, x2 and x4
- Maximum input frequency: 1 Mhz
- Minimum track width Z-track: 200 ns
- Maximum voltage range ref. to DGND: 5 V DC (TTL)

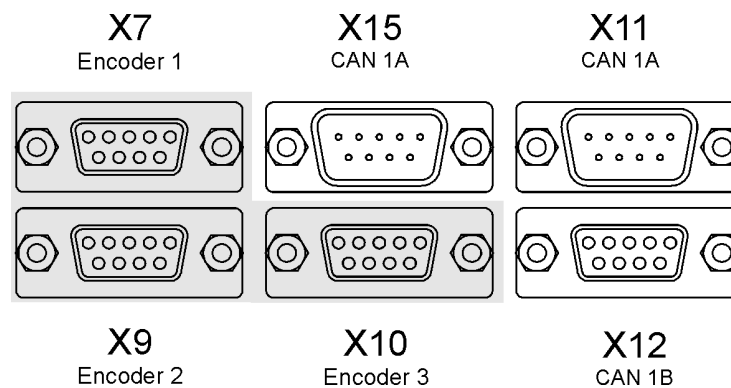
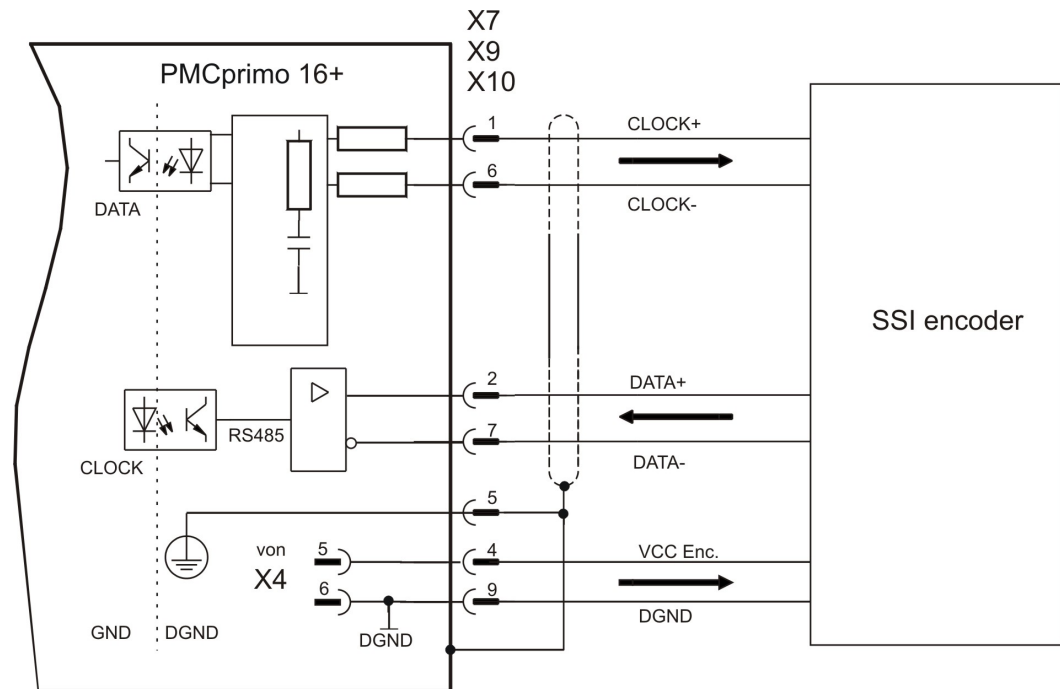


9.6.2. Absolute encoder (SSI)



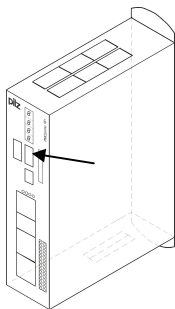
- Reference ground is DGND (connector X4 Pin 6 + 8)
- Number of data bits: 13..32
- Format: Binary or gray
- Frequency SSI-Clock: 100 kHz or 300 kHz
(change with command **FS**, see PMCprimo programming manual)
- Maximum voltage range ref. to DGND: 5 V DC (TTL)

Note: Alternatively absolute encoder can be also connected by the CAN-open interfaces.



9.7. Bus interface (MODBUS / Profibus DP-S small)

9.7.1. General



As a comfortable way to set parameters the PMCprimo 16+ offers a MODBUS-interface (X8). You can directly connect our MODBUS-panels (e.g. PMI 315).

In networked systems (CAN) the panel has to be connected to the host system. Only the host's MODBUS-interface is active in this mode.

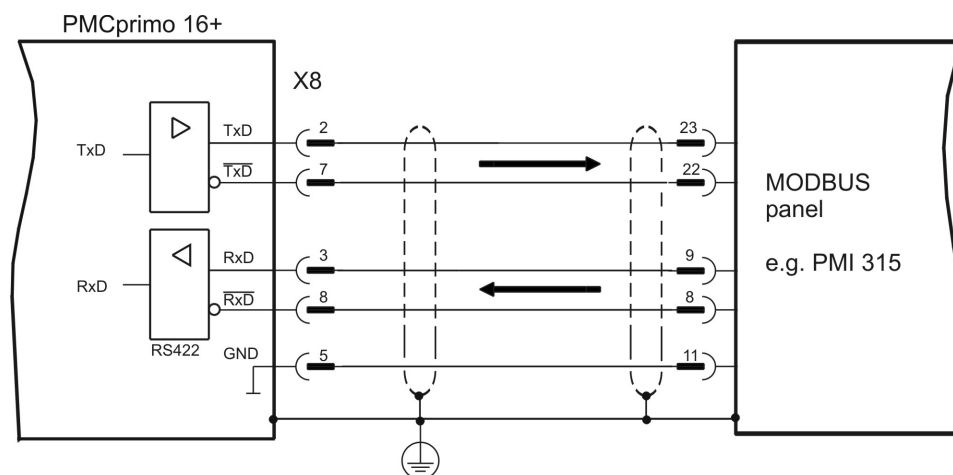
The PMCprimo 16+ is equipped alternativ with MODBUS or Profibus DP-S small. The connection is done always by the connector X8. When using the option Profibus DP-S, the MODBUS is out of service.

9.7.2. Interface

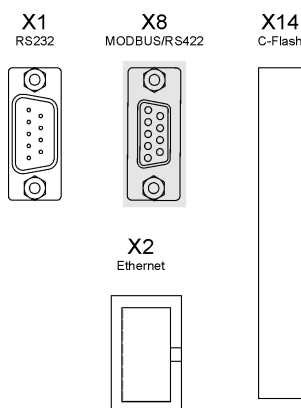
The communication uses a 5-core cable (RS422 full duplex). The communication parameters are:

- 9600 Baud, 8N1, no handshake

With the command "**BM**" the baud rate can be changed (see PMCprimo programming manual)

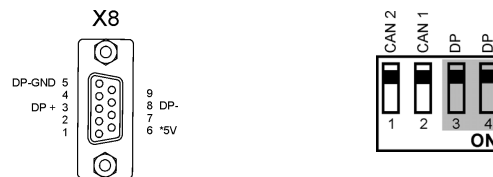


Pin	Description
2	TxD (send data)
3	RxD (receive data)
5	0 V (analog ground)
7	/TxD (send data inverted)
8	/RxD (receive data inverted)



9.7.3. Bus interface Profibus DP-S small

The setting for the Profibus parameters can be done with the "CD" command (see PMCprimo programming manual). With the DIP-switches 3 and 4 the Profibus termination can be set. To activate the termination, both DIP-switches must set to ON.



Pin	Description
3	DP+
5	DP-GND
6	5 V
8	DP-

The needed GSD-file (HMS_1810.GSD) is located on the CD-ROM (also see example 10.11.3)

9.7.4. Using the MODBUS / Profibus interface with PMCprimo

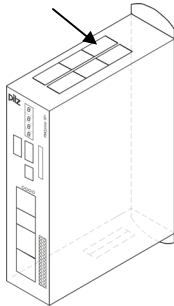
With the MODBUS / Profibus up to 108 bus-variables (MODBUS), respective 16 bus-variables (Profibus DP-S small), can be read or write.

- Notation: \$B1 - \$B108 (see PMCprimo programming manual „bus variables“)
- Data bits : 16 Bit (=2 Bytes = 1 Word) signed.
- Range: -32768 to 32767 (Hex: 0x8000 to 0x7FFF).

Bus variables can be defined as trigger variables, so a program can be executed when the variable is updated.

9.8. CAN bus interface

9.8.1. General



With the CAN bus interface CAN-1A (X11) and CAN-1B (X12) up to 60 PMcprimo-motion control-systems can be linked together.

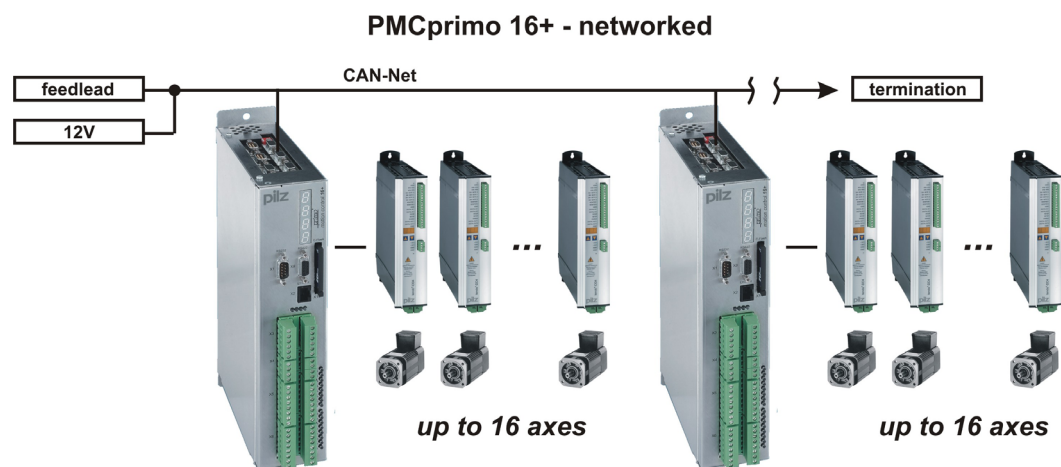
The bus speed is 500kBit/s. Additional safety signals provide fault detection.

Much more details about linking CANopen devices are included in the manual „PMcprimo CAN-network“.

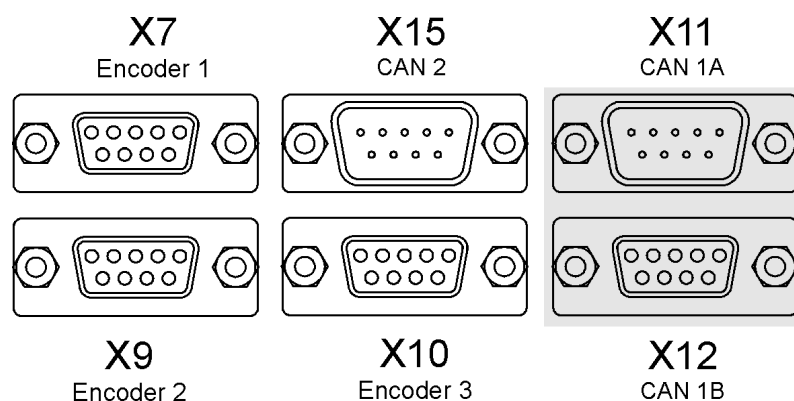
The manual is part of the enclosed CD-ROM “Motion Control Tools“.

9.8.2. Linking PMcprimo-motion control systems (CAN –1)

On each system CAN-1A (X11) and CAN-1B (X12) of the next system are linked together in the way as shown below:



Pin	Description
1	CAN Error (is switched against CAN-GND when failure)
2	CAN-L
3	CAN-GND
4	Relais contacts (opened when failure)
6	CAN-GND (connected internal with pin 3)
7	CAN-H
9	CAN-V+ (12 V-supply voltage)



9.8.3. CAN bus cable

The interface cable is a 1:1 connection (9-pole SUB-D socket to 9-pole SUB-D plug).

- Characteristic impedance: 120 Ω
- Cable capacitance : max. 60 nF/km
- Lead resistance (loop):: 159,8 Ω /km
- Max. cable length : 70 m (1st. to last node)

For EMC reasons, the SUB-D connector housing must fulfill the following conditions:
metal or metallized housing provision for cable shielding connection in housing,
large-area connection.

You have to terminate the first and the last node (120 Ω).

9.8.4. Speciality 1st node

- The 1st node is supplied at CAN-1A (X11, Pin 9) with +12V , at Pin 3 CAN-GND (0V).
- Minimum power dissipation of the power supply unit: 1 VA each node.
- An additional resistor 10 k Ω (250 mW, metall 1%) between Pin 1 and Pin 4 is necessary.

9.8.5. Speciality last node

The last node needs a jumper bridge (0 Ω) at CAN-In between Pin 4 and Pin 9.

9.8.6. CAN-cable and accessories

Position	item number
CAN-connection cable (1:1) 700 mm	1803117
CAN –feedlead 12 V	0802951
Termination	0802950
Power supply 12 V	4803002

9.8.7. Fault detection

The following faults will be detected:

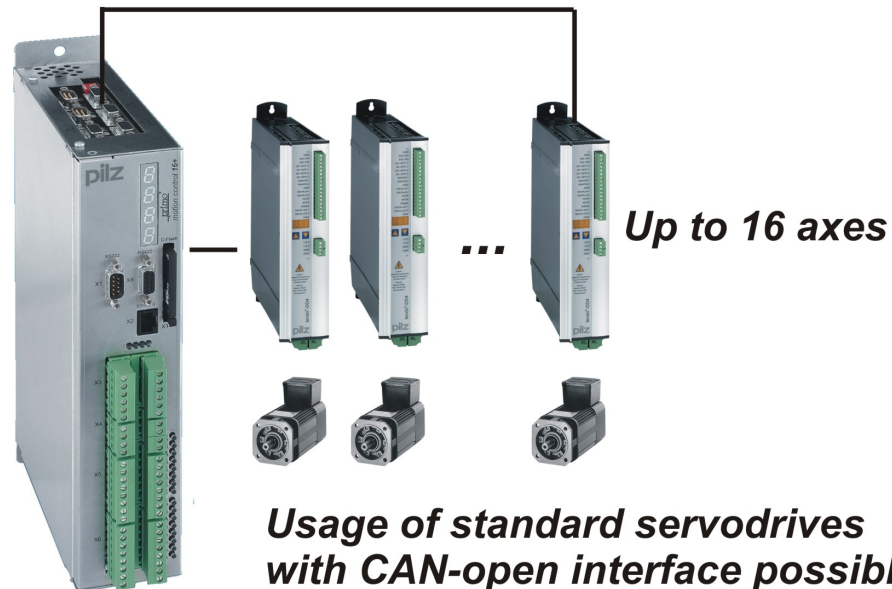
- Missing or defect +12V-CAN power supply
- Malfunction of a bus node
- Break of the CAN bus cable

9.8.8. Connecting external CANopen bus devices (CAN-1 or CAN-2)

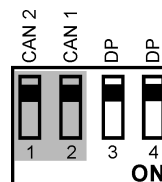
It is possible to connect external CANopen devices with PMCprimo-motion control-systems. With e.g. a CAN-I/O module you can increase the number of inputs and outputs in the system.

A CANopen encoder or CANopen panel can also be used.

Example for networking



Hint: The terminators ($120\ \Omega$) for CAN-1 and CAN-2 can be activated via DIP-switches. For this example the DIP-switches 1 and 2 must be set to "ON".



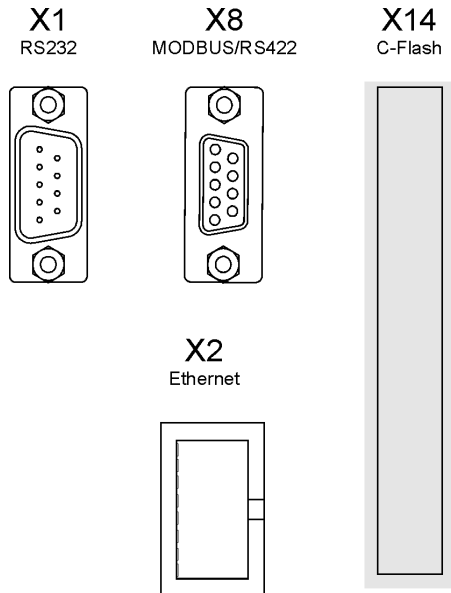
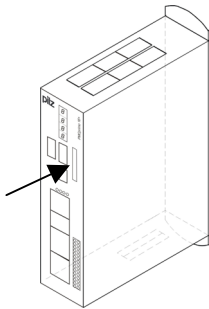
The 12 V DC feed is not applicable by this kind of networking. For the wiring of the CAN-bus, cables from our standard program (see page 45) can be used.

9.9.

Compact Flash interface

With the Compact Flash interface an easy data exchange with other systems is possible. Standard CompactFlash cards type I + II can be used.

You can receive further technical informations in the file "TI_CF_CARD_GB_001.pdf" on the CD-ROM.



9.10.

Virtual inputs and outputs

In addition to the real digital inputs and outputs there are 8 virtual inputs and 8 virtual outputs on each PMCPrimo 16+ system.

The virtual inputs and outputs don't have any terminals. But all input and output commands are available (see PMCPrimo programming manual).

9.10.1. Terms

Virtual inputs: E3:1 – E3:8

Virtual outputs: O3:1 – O3:8

The virtual inputs and outputs are connected (internal) together as shown below:

Output O3:1 with input E3:1

Output O3:2 with input E3:2 etc.

9.10.2. Application example

You define a position output on the virtual output 0.3:2.

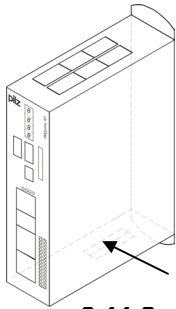
If you define an input function on input 0.3:2, this program will be executed each time the output 0.3:2 is set.

You don't need any wiring!

For further details see PMCPrimo programming manual.

9.11. Fieldbus interface

9.11.1. General



At the fieldbus interface X13 several fieldbus modules can be mounted inside the PMCprimo 16+. There are modules for e.g. Profibus DP, DeviceNet or Interbus-S available (see type key page 5).

The fieldbus modules are delivered already inserted. The original manufacturer's documentation is enclosed (english language). It can be found on the CD-ROM „Motion Control Tools“ in PDF format.

Additional files, e.g. GSD files (Profibus DP) are on the CD-ROM, too.

9.11.2. Using the fieldbus with PMCprimo

With the fieldbus 108 bus variables can be used for data exchange (depending on the fieldbus module).

- Notation: \$B1 - \$B108 (see PMCprimo programming manual „bus variables“)
- Data bits : 16 Bit (=2 Bytes = 1 Word) signed.
- Range: -32768 to 32767 (Hex: 0x8000 to 0x7FFF).

9.11.3. Example Profibus DP slave module

After setting the slave address (turn switches on Profibus module) and termination (DIP-switch) PMCprimo 16+ can be powered on. Following message appears when the module is recognized.

S T A R T

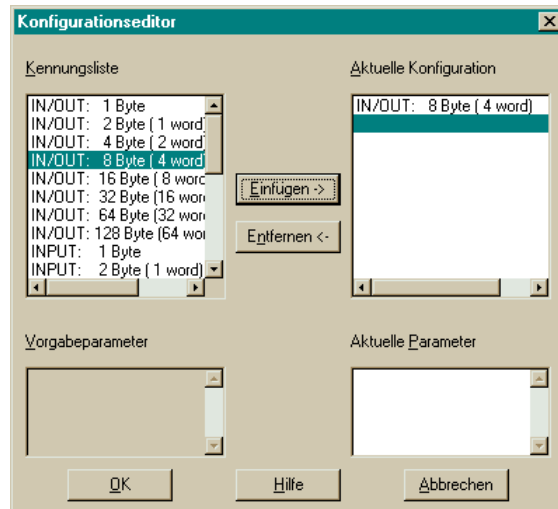
```
Ser.Nr.:90, Version 1.006 May  9 2001, 10:03:03
Operate Mode: HOST+NODE
MOTION INSTALLED
ETHERNET INSTALLED
Profibus-DP-Module found
Channel 0.1 found
Channel 0.2 found
Channel 0.3 found
Channel 0.4 found
```

In this example the bus variables \$B1 up to \$B4 are read and written (4 Words = 8 Bytes at all). The configuration of the PMCprimo 16+ is done with the command **CD**.

```
0.1: cd
0.1:
Actual configuration:
Operate Mode: STANDALONE
Actual IP address 10.10.180.101
Actual Netmask 255.0.0.0
Fieldbus In/Out length 50 words
Change Operating Mode? Y/N: N
Delete application data? Y/N: N
Change Ethernet? Y/N: N
Change Fieldbus configuration? Y/N: Y
New In/Out length in words (50) ? 4
Change Fieldbus configuration? Y/N: N
0.1:
```

Subsequent the Profibus-DP-Master hat to be configured to IN/OUT: 8 Byte (4 word). The GSD file is named: HMS_1003.gsd.

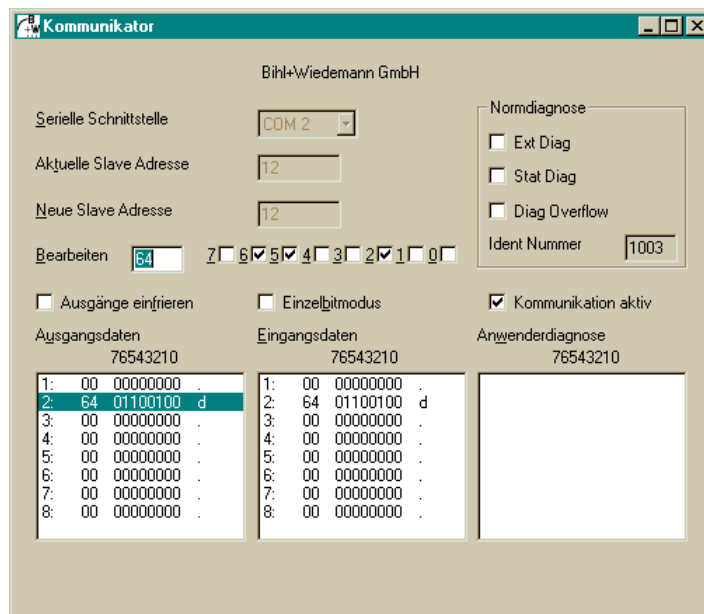
Example: Profibus DP Master simulator:



After starting the Profibus communication the red LED goes out and the green LED indicates a successful initialisation.

Now bus variables can be set or read.

Example: Setting the bus variable \$B1 to value 100 (0x0064)



0.1: \$B1=100 (0x00000064)

If bus variables are defined as trigger variables (see PMCprimo programming manual), a program can be executed when the variable is updated.

10. Commissioning

10.1. Important notes



Only professional personnel with extensive knowledge in the fields of electrical/ drive technology are allowed to commission the control.

The procedure for commissioning is described as an example. Depending on the application, a different procedure may be sensible or necessary.

The following instructions should help you to carry out the commissioning in a sensible order, without any hazards to people or machinery.

Check installation	Disconnect the control from power supply.
Power on the PC starte PTERM and connect to the control.	Connect PC and control with serial cable (page 30) or Ethernet cable (page 32).
Switch on the 24 V power supplies	Switch on 24V CPU, 24V I/O, encoder supply and CAN supply (main switch).
System is booting. Display status and error messages	After booting and initialisation(ca. 6s) status codes (page 51) and possible error codes (page 51) are showed on the LED-display.
The control is ready to operate	The programming is described detailed in the PMCprimo programming manual.

10.1.1. Error messages

Errors which occur are shown in coded form by an error number in the LED display on the front panel.

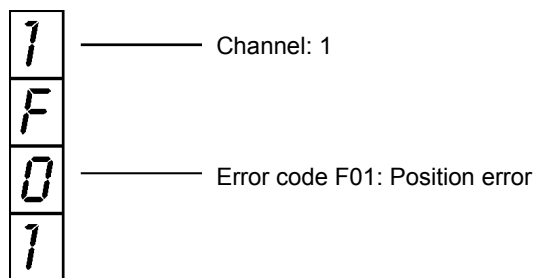
All error messages are also displayed on the connected terminal program (e.g. **PTERM**)

10.1.2. Error codes

number	meaning
F01	Position error
F03	High position limit
F04	Low position limit
F05	Reference timeout
F06	Reference out of limits
F07	Reference overrun
F13	Encoder timeout
BATT	Buffer battery almost empty, should be replaced immediately → p. 53

10.1.3. Error numbers on LED display

Example for an error number:



10.2. Status messages

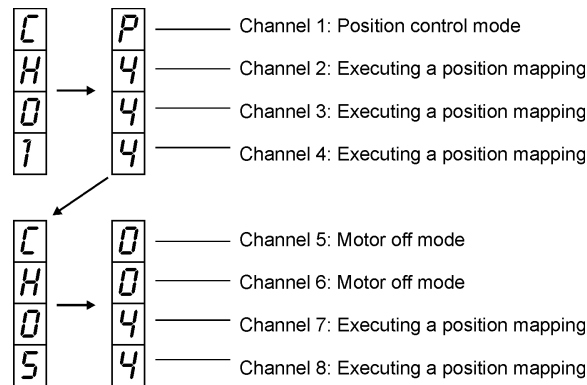
The status of the particular axes as well as the current operating condition is also showed on the display. Every digit of the display corresponds on axis. The display shows 4 axes simultaneously in change.

10.2.1. Status codes

Display	Meaning	Command
P	Position control mode	PC
0	Motor off mode	MO
1	Velocity control mode	VC
2	Moving to new position	MA, MR
4	Executing a position mapping	XM
5	Stopping under normal deceleration	ST
6	Initializing to reference position	IN, IB
7	Torque control mode	AM, XM
9	Waiting	WA, WB, WI, etc.
A	Alignment move	XM
C	Software clutch	XM, ST

10.2.2. Status codes on LED display

Example of a status code:



11. Appendix

11.1. Replacement of the buffer-battery

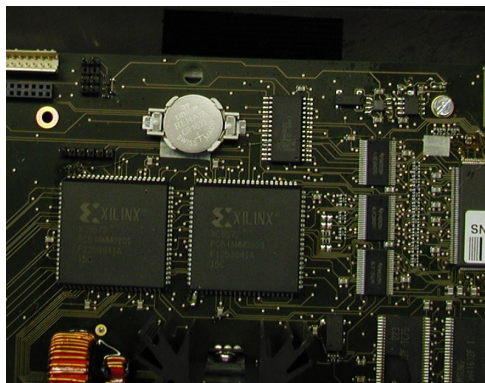
The buffer-battery must be replaced, when the display shows the message **"BATT"**. With present 24 V supply voltage, the buffer content remains.



Type of battery: CR2032

Procedure:

1. Connect the 24 V CPU-supply voltage (connector X4 pin 1+2)
2. Open the case (4 screws M3)
3. Change the battery (regard polarity)



4. Close the case
5. Checkup: the display message **"BATT"** expires and shows the actual status of the controller

ESD!

ESD : electrostatic discharge
ESDS : electrostatic sensitive devices



Motion control units contain electrostatic sensitive devices which will be damaged by electrostatic discharge. Therefore servicing shall only be performed in ESD safe areas and by ESD protected personnel.

11.2. Removing faults

The table below will help you with common problems.

Error	possible causes	Measures to remove the cause of the fault
LED display keeps dark after power on	— no power supply — internal fuse damaged — system still booting	— connect 24 V-CPU supply — watch power dissipation — open the housing and replace fuse — no error! Booting takes about 6 s.
no RS232-communication possible	— wrong COM port selected — wrong baud rate with BD in autostart program	— Select right port in PTerm — select right baud rate in PTerm or press CTRL + E after power on and delete application data
no Ethernet communication possible	— wrong IP address or address reserved from other device	— change IP address
no encoder signals	— missing encoder power supply — channel in virtual mode — wrong encoder type or data bits selected — no encoder connected	— check power supply — set channel to real mode with VM0 — check values for FS and NB — connect encoder (on the right channel)
no digital outputs available	— missing I/O power supply — output still defined as cam — short circuit	— connect 24 V power supply, watch power dissipation — redefine output with UO command — remove short circuit
digital inputs can not be read	— voltage range to low — short circuit — input masked — missing ground connection	— min. voltage HIGH: 18 V — remove circuit — enable input with EI command — connect ground
motor goes in position error	— feedback setup incorrect — no drive enable signal — wrong control parameters (KP, KF)	— change control word CW — check wiring — set parameters to default
motor is moving in wrong direction	— counting direction and sign of demand signal reversed	— change control word CW

11.3. Transport, storage, maintenance, disposal

- Transport:**
- only by qualified personnel
 - only in the manufacturer's original recyclable packaging
 - avoid shocks
 - Temperature -25...+70°C, max. 20K / hour rate of change
 - Humidity max. 95% relative humidity, no condensation
 - The PMCprimo 16+ contain electrostatically sensitive components which can be damaged by incorrect handling. Discharge yourself before touching the control. Avoid contact with highly insulating materials (artificial fabrics, plastic films etc.).
 - Place the PMCprimo 16+ on a conductive surface.
 - if the packaging is damaged, check the unit for visible damage. In this case, inform the shipper and the manufacturer.
- Maintenance:**
- the instruments do not require any maintenance
 - opening the enclosure invalidates the warranty
- Cleaning :**
- if the casing is dirty, clean with Isopropanol or similar cleaning agent
do not immerse or spray
 - dirt inside the unit must be cleaned by the manufacturer
- Disposal :**
- the PMCprimo 16+ can be reduced to its principal components by removing the screws(steel-housing, electronic boards)
 - disposal should be carried out by a certified disposal company.

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